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SYMBOLIC MEDIATION AND ORGANIZATION OF THOUGHT: AN EXPERIMENTAL APPROACH BY MEANS OF THE LINE SCHEMATIZATION TECHNIQUE*[1]

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HEINZ WERNER AND BERNARD KAPLAN

A. INTRODUCTION

When first approaching the problem to be discussed in this paper, we thought of it as a rather straightforward one, namely, the relation between the verbal language an individual speaks and hears and the underlying psychological experiences. Most students of language have recognized that verbal formulation is not a direct reflection of what goes on within ourselves when we speak or hear. The recognition of this discrepancy between language and experience has led some psychologists in the past to search for a method for penetrating the veil of language to get at the experience *per se*.

The most significant group to attack this problem was the so-called Würzburg School. They approached the problem through a purely introspective method, searching their awarenesses for the experiential concomitants of verbal messages. Since they frequently found nothing in their awarenesses which fit into their categories for introspective observation, many of them concluded that there could be experience of verbally conveyed messages without any material or sensuous mediation.

Since we felt that it was a psychological impossibility for verbal messages to have meaning without some material or sensuous involvement of the organism, we originally viewed our first problem as one of finding a method by which one could bring to the fore objective indices of the experience of meanings when we hear and use verbal material.

We had in mind indices that would fulfill certain general criteria: (*a*) They had somehow schematically to reflect the bodily organization of the experience; (*b*) they had to be externalized or visible, that is, intersubjective; (*c*) they had to be sufficiently articulated so that they would be capable

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[1] The experimental studies reported in this paper were carried out at the Clark Psychological Laboratories with the support of the Ford Foundation and the Foundations' Fund for Research in Psychiatry.

of depicting certain experiential differences; and finally (*d*) they had to allow for the reflection of a wide range of organismic organizations, including those which approximate the structures of the verbal messages.

These criteria led us to look for media other than verbal speech in which bodily experience underlying verbal messages could be externalized. Among the possible media available, body gestures stood out. Closely tied up with bodily activity and organization, one could easily see how they could be utilized to depict experiential organization. However, we were quickly aware that gestural activity has certain characteristics, e.g., refractoriness to fixity, relative non-observability to the performing subject, etc., which limited its general usefulness for our purposes.

At this time we struck upon a medium, somewhat similar to gesture, which, we felt, retained the virtues of the gesture medium without suffering from its limitations: this medium is that of expressive lines. The line medium appeared to us to allow the expression of indices satisfying all of the criteria mentioned before; furthermore, it had the particular advantage of non-traditionality, i.e., it was a medium not conventionally used in our society for the organization or communication of experience.

Up to this point, we had implicitly accepted the notion that there was such an entity as a general unmediated experience, or that thought *per se* had the same character irrespective of its different expressions in varied material media. Further thought on these problems, however, led us to the rejection of a dichotomy between experience and mediation. Our thinking moved in a direction which philosophically has been expounded by Kant, Cassirer, Dewey, and others. This reorientation necessitated a reformulation of the original exposition of our problem. We recognized that it is not tenable to talk of the relations of verbally formulated to unformulated experience; but rather to view experience as necessarily mediated, i.e., experience coming-into-being and formed in terms of different material media, such as verbal code, gesture language, linear expression, etc. With this change, our focus shifted to a comparative analysis of media; and furthermore to the related problem of a developmental analysis of mediation.

Such comparative and developmental considerations lead us to a discussion of earlier and later levels of mediated cognition and serve to locate linear mediation within a genetic sequence. The acute observations of child psychologists (Piaget, Erikson, and others) suggest that bodily movements of the young infant, initially used solely in the service of adjustment, are soon exploited as mediating devices for the apprehension of organism-environment relations, for primitive categorization, and for primitive communication (cf. Erikson's zones and modes, Piaget's schemata, etc.). Most child psychologists are in agreement that, at this stage, there is no sharp differentiation between body activity in the service of need satisfaction and body activity as a device for mediating the organization of experience.

The first manifestation of a relatively clear-cut separation of body movement used for need satisfaction and body activity used for cognizing the world is found in pre-linguistic mimetic gestures of the child. A classic example, illustrating this level of mediation at a prelinguistic stage, comes from the *Autobiography of Helen Keller.* In regard to a period before she was capable of grasping the fact that tactual patterns impressed in her hand could be used as symbols to refer to events and experiences, she reports how she utilized imitative gestures to picture a desired object:

> The guinea fowl likes to hide her nest in out-of-the-way places, and it was one of my greatest delights to hunt for the eggs in the long grass. I could not tell Martha Washington when I wanted to go egg-hunting, *but I would double my hands and put them on the ground,* which meant something round in the grass and Martha always understood.

One may observe that there was here an intimate tie between the movement mediating the representation and that which was represented, i.e., there was no arbitrary relationship between the mediating symbol and what it signified. In the sense that any symbol is used to depict in its own structure the structure of that which it signifies one might speak of a "natural symbol."

In contrast to mediation on this early level of representation by natural symbols, one finds, at the most advanced levels for organizing and categorizing experience, symbols which in themselves have no analogical or quasi-pictorial relationship to what they signify. Thus, as typically exemplified in scientifically used verbal language, the meaning represented by a sound vehicle is not, in general, depicted in the phonetic features of the vehicle. In the sense that there is no quasi-pictorial representation, one can speak about "conventional symbols" in contrast to natural symbols.

B. FIRST STUDY

1. *The Expressive Line Medium*

Now, during the developmental course from natural symbolization to conventional symbolization, there are a number of media which, to a greater or lesser degree, tend more easily to exploitation by natural symbolization.

One such medium, mentioned above and used in the experimental studies discussed here, is the expressive line medium. As will be made clear later on, subjects in general, in using the line medium, use modifications of properties of lines for purposes of *depicting* the apprehended relationships in linguistically conveyed meanings. Compared with linguistic forms for representing meaning, the linear constructions are relatively non-conventional, i.e., they present an analogy in terms of form to that which they signify. In this sense, the products in the line "language" are generally closer to the natural symbols of gesture than to the conventional symbols of scientific language and much of everyday discourse.

To give some understanding of the way in which the linear schematization technique was employed the general procedure shall be briefly presented:

After rapport is established and the subject is acquainted with the fact that he is to participate in a study on speech or language behavior, the following instructions are given:

> We've often found that people can express the meaning of words or sentences without using other words. They might, for instance, use line drawings, colors or three-dimensional patterns, like wire patterns, etc. For example, here are two lines drawn by the same person—one to represent the word "sad," the other to represent the word "gay" (Figure 1).

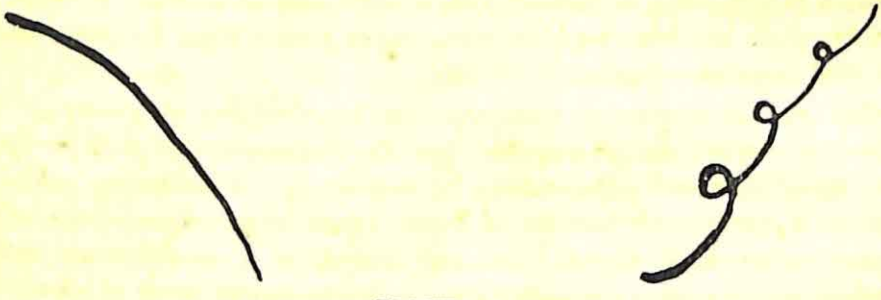

FIGURE 1
ONE LINE TO REPRESENT THE WORD "SAD," THE OTHER TO REPRESENT THE WORD "GAY"

> Many people would go along with the person who drew these lines in taking the first drawing as representing "sad" and the second as representing "gay." Of course, there are no right or wrong answers here; one can represent a word any way he wants.

After this introduction, the following procedure is carried out:

> A. *Initial Drawing:* The subject is asked to express the meaning of a word (phrase, sentence) in the non-linguistic, linear medium.
>
> B. *First Inquiry:* After the line schemata are drawn, the subject is then asked how each drawing expresses the particular word (phrase, sentence) it was designed to represent.

C. *Second Inquiry:* Here a more specific inquiry is undertaken. The subject is requested to give:

1. A more specific designation of how and why aspects of the drawing express the elements of the statement. (Subject is told that there does not have to be any correspondence—he is just asked to see if there is any.)
2. An account of those linguistic elements which are not expressed in his schema.

(This general procedure might be varied slightly in different experimental situations.)

D. *Third Inquiry:* The subject here is asked whether and in what way the following aspects of linear schematization play a rôle in his expression of any particular word (phrase, sentence) meaning:

1. Size
2. Shape
3. Direction
4. Pressure
5. Width
6. Number
7. Length
8. Form
9. Balance
10. Symmetry
11. Continuity
12. Tempo

E. *Fourth Inquiry:* Where the experimental design warrants, the subject is asked to make comparisons among line schematizations of meaning.

F. *Fifth Inquiry:* The subject is asked to retranslate his schemata into words.

With this briefing as to our general experimental method, we turn now to some of the problems we have attempted to handle using the linear medium and the line schematization technique.

Our general assumption concerning the inseparability of experience from mediation implies the proposition that the employment of different media may entail different organizations of experience. This notion guided us, first, to a comparative analysis of linear organization of experience as contrasted with verbal organization and second, to a consideration of both types of experiential organization from a developmental point of view. Our general developmental expectation was that the individual, linearly expressed, experience would be characterized by a greater primitivity of organization than the communally coded verbal expression which was used by the experimenter to prompt the subject's line drawings. Our developmental orientation further led us to hypothesize that organizations of experience in the line medium would correspond more closely to the verbal linguistic patterning of experience in more primitive societies and in our own society at earlier periods than to the verbal codification typified by modern western languages.

Some findings from one of our studies may serve to illustrate our general approach. In this study, each subject was presented with four sets of three sentences, each set containing on one hand, the same pronoun and invariant

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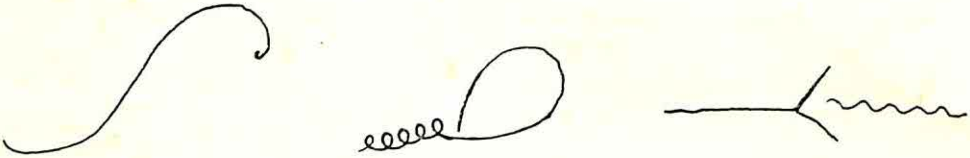
verb in each sentence, and on the other hand, a different grammatical object in each sentence, e.g., "he catches a fly," "he catches a lion," "he catches a criminal." Four verbs were used: "opens," "loves," "catches," "closes," with different objects for each verb.

Now it was possible for the subject, if he was so inclined, to represent these sentences linearly in relatively close structural analogy to the codified language. It was also possible for the subject to express fusions of pronoun and verb, fusions of verb and object, etc.

2. *Results*

It is quite clear from our results that on the level of linearly expressed experience, the verb is not generally apprehended as an isolated, freely combinable element; it has not reached a level where it is abstracted from its object context. Let us illustrate this with the following typical schematizations from a subject (Figure 2).



He catches a fly He catches a lion He catches a criminal

FIGURE 2
THREE TYPICAL SCHEMATIZATIONS FROM A SUBJECT

Thus, with regard to drawings, the "catches" of "he catches a fly" is expressed as a smooth relatively fast, continuous activity; the "catches" of "he catches a lion" is expressed as a slow arduous activity; the "catches" of "he catches a criminal" is expressed as a harsh, direct, serious activity.

Strictly speaking, of course, there is no one-to-one correspondence between the linguistic elements and the line language, i.e., there is no element in the drawings of the line "language" which corresponds to "catches" in isolation. Thus, in the first case the total symbol expresses in a relatively undifferentiated way the "sort of he who is in the upward-reaching, graceful, continuous activity of incorporating or sweeping in a small object. . . ." In the second case, the differences in shape and size of parts of the total symbol express in a relatively undifferentiated manner the "difficulty, but eventual success, of an individual smaller than the object he catches, in the process of catching (all expressed by spirality upwards) . . . catching an organism larger than himself (all indicated by the loop) . . . ." In the third case, the straight, horizontal, dark, forked line expresses "he, serious-of-purpose, engaged in the direct forceful, harsh (because of the nature of the criminal) activity of catching . . ." etc.

We may now examine in a general way the degree to which the subjects tend to vary the linear expression of a verb depending on the variation of the object. Since there are three contexts for each verb and 12 subjects giving responses, a total of 36 responses were obtained for each verb; these were categorized in terms of three steps along the dimension: invariance of verb to marked fusion of verb and object. Invariance is characterized by the absence of change in the representation of the verb; modification is characterized by slight changes in the representation of an otherwise similarly symbolized verb; fusion is characterized by a radical change in the representation of the verb with each grammatical object.

From Table 1 we see that most of the responses for all of the activities (verbs) involve a marked variation in the expression of the activity with changing context—i.e., the invariance of the verb in the codified language is typically absent in the linear expressions.

TABLE 1
DEGREE OF FUSION IN SYMBOLIZATION INDICATING DEPENDENCE OF ACTIVITY ON GRAMMATICAL OBJECT
(12 Subjects)

Activity (Verb)	Invariant	Modification	Fusion
"Open"	0	6	30
"Loves"	0	11	25
"Catches"	3	9	24
"Closes"	0	2	34
	3	28	113

3. *Discussion*

One may conclude from this study that typically, in linear organization of experience, there is a relative fusion, interpenetration, and lability corresponding to what on the English language level is codified as relatively autonomous, clearly contoured, and invariant classes of experience. Since we know that ontogenetically earlier forms of *verbalized* cognition are characterized precisely by such fusions, interpenetrations and variations of meanings,[2] it seems justifiable to regard an individual's linear structurization of experience, compared with his verbal structurization, as likely to be developmentally more primitive.

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[2] Also characterized by such properties are admittedly primitive experiences like the dream, hypnogogic phenomena, hallucinations, etc. (Freud, Silberer, *et al.*).

In this light, we may very briefly examine our above-mentioned expectation that the typical experiential organizations in the primitive line medium might correspond more closely to experience as codified in certain linguistic structures (found in primitive societies) than to experiential structurization in other linguistic codes (found in more civilized societies).

We may refer for instance to a comparison between the linguistic code of the Navaho compared with the English linguistic code, as discussed by Kluckhohn. This author, in his book on the Navaho, describes their code as "an excessively literal language, little given to abstractions characteristic of English. The general nature of the difference between Navaho thought and English thought is that Navaho thought is prevailingly so much more specific, so much more concrete"(3). This concreteness shows itself in the fact that verbs denoting a general action, such as "give," "go," etc., do not exist here. "The Navaho verb is rather like a tiny imagist poem; a word, with its verb stem as nucleus, more often than not has to be translated into English through a whole sentence" (3). In particular, the verb stem is not a self-dependent form but shows its dependency on the object by its variation with the type of object participating in the event. Thus, there is no such thing as saying "I give" in Navaho—there are more than 20 different forms, one of which must be chosen to accord with the nature of the objects given. These class stems embrace such categories as: the long object class (pencil, stick, pipe); the slender-flexible object class (snakes, thongs, etc.); the things-bundled-up class (hay, bundle of clothing, etc.); the bulky-round class, and so on.[3] This kind of codification is paralleled in its essential aspects by the above-mentioned "line-codification" of our subjects where the linear presentation of verbal activity is a function of the object. If such linear codification would be the basis for linguistic codification, verbal construction might be of a type similar to that of the Apachean languages with their characteristic classificatory verb stems (2). Just as the Navaho has two "gives" for: "give-things-bundled up-wise" and "give-bulky-round-object-wise," so could one translate the linear schemes for "catches," presented by the above-mentioned subject into, "catches fly-wise," "catches lion-wise," and "catches criminal-wise."

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[3] l.c., p. 191. Cf. also D. Westermann's analysis of "give" in Western Africa Sudan language: Laut, Ton und Sinn in Westafrikanischen Sprachen. *Festschr. Meinhof*, 1927, p. 315.

C. SECOND STUDY

Up to this point, we have compared the operation of two developmentally different media for experiential articulation and organization, and discussed the nature of symbols in these different media.

1. *Purpose*

A second study may serve to illustrate the usefulness of the line schematization technique for investigating such general problems as the formation of *symbols* and the creation of *symbol systems* for articulating and fixating related references. We may elaborate briefly on why we use this experimentally introduced medium rather than the verbal linguistic medium to help us understand and contribute to the solution of the problems of formation and systematization of symbols.

In order to study experimentally the way in which an individual creates symbols and systems of symbols for ordering his transactions with the world, it is necessary to inquire at a level where these creative processes can be examined, i.e., at a level where the handling of the dimensions of the material medium both depicts that which one seeks to signify and also shows in the medium the basis for systematic differentiation of meanings.

Now on the level of the verbal language, the sound medium is indeed systematically modified to reflect differences in the apprehension of events. However, the changes in sound patterns, as systematic as they may be for classifying and ordering experiences, are from a logical point of view arbitrary, i.e., the changes when introduced do not generally embody in the material structure the picture of that which they represent. A further limitation in using the verbal medium for investigating the ongoing processes relating material to semantic differentiation and systematization is that the verbal medium has already been pre-empted for social communication and has already been segmented for us; thus there is practically no room for creating new vehicles in a socialized language and relatively little room for modifying the structural arrangement of vehicles.

On the other hand, the line medium, as has been mentioned before, is one which, like gesture, permits the close tie of symbol and significate, so that variations in the symbol are not usually arbitrary but depict changes in signification, e.g., pressure changes may depict intensity differences.

Again the line medium is a novel medium which has in general not been previously structurized either for communal or individual expression of experience. Therefore, the individual is obliged to construct his own symbols rather than to adopt the "compulsorily coded" forms (R. Jakobson) of his verbal linguistic community.

If we want to understand how developmentally earlier media involving natural symbols are manipulated in the process of systematizing expressions of meanings, it seems most advantageous to compare and contrast experimentally our induced linear systematizing tendencies with already available systematizations on the highest levels of expression, viz., in the verbal code. To this end we thought of a domain of experience which is sufficiently well-ordered in our linguistic code, i.e., tense differences for a particular activity.

2. *Procedure*

Our procedure was as follows: 12 *S*s were individually tested. Each subject was given the general instructions about the possibility of the expression of meanings in line patterns. Then he was told that he would be presented with four verbs, each verb to be given in four different tense formations, viz., the simple present (*SP*), the progressive present (*PP*), the past (*P*), and the future (*F*). He was then asked to schematize in lines four sentences for each verb. That is, he was asked to draw lines for: "He runs"; "He is running"; "He ran"; "He will run." The other three verbs used were "try," "yield," and "love." After the line-drawings, the usual inquiries were carried out.

Although from the point of view of production, each line schematization of any subject is a unified gestalt, for purposes of analysis, a line drawing may be conceived as comprised of a number of properties, e.g., length, pressure, direction, etc. We shall henceforth call these properties of the linear schematization, *dimensions* of the line medium. Should any dimension show variation so as to differentiate two different schemata, e.g., long line versus short line, or heavy line versus light line, we will adapt for our purposes the linguist's concept of *diacriticum*.

Now, in examining the various line schematizations and remarks of the different subjects, one is immediately struck by the differences in the exploitation of dimensions of the linear medium for purposes of symbolic and semantic differentiation and systematization. These differences are manifested in a number of different ways: (*a*) there are individual differences in the degree to which various dimensions constituting the line-drawings are separated from each other in expressing different semantic functions; (*b*) there are differences in the degree to which the many possible dimensions of the linear medium are actually used for *diacritically* discriminating linguistically ordered temporal differences; (*c*) there are individual differences in the degree to which dimensions are generally and uniquivocally used for the expression of ordered temporal differences.

Before discussing some of the findings concerning the expression of verbally formulated temporal differences by linear schemata, we shall first briefly recall the nature of the line medium as a primitive "language." The use of the line medium invites the subject to express simultaneously in one schema the linearly expressible precipitate of his total experience. Concretely, the line medium promotes the global expression of what on the verbal level is separate. Now ideally, systematization of the temporal features of activity, i.e., differentiation and ordered arrangement of time *per se*, requires some material modifications which are invariantly connected with the positions in the temporal order and are not contaminated by expressors of the activity *per se*. In the verbal-linguistic code, there is some approximation to this general, independent temporal systematization through the use of morphemes whose main syntactical function is the expression of time; for example, suffixes, prefixes or auxiliaries. Thus we have a means, e.g., through "does," "did," and "will," preceding the expression of the activity, to locate any activity in the present, past, and future respectively.[4]

To achieve this degree of systematization in the line medium, one would have to introduce variations within a single dimension, which would be used in the same relative way for the same tense formations regardless of the expression of the particular activity. A hypothetical illustration of such a general systematization of tense in the linear medium is presented in Figure 3.

3. *Findings*

In the light of the above, we shall discuss some of our empirical findings concerning the relation between systematization and the individual differences in linear expression.

a. One problem concerns the degree to which dimensions are lifted out of the totality of schemata for the purpose of expression. None of our subjects achieved in the use of the line medium a systematic expression of temporal differences as general as that depicted in the ideal case of Figure 3. From our understanding of the relative primitivity of the line medium, one can appreciate why this is so. Too many factors involved in the expression

---

[4] In these cases, the intentional function of "will," for example, has faded and it has become an index of future to a great extent. Nevertheless, it may on occasion have a voluntative or intentional function. Rigorously speaking, there are in English no indices whose sole function is the expression of future.

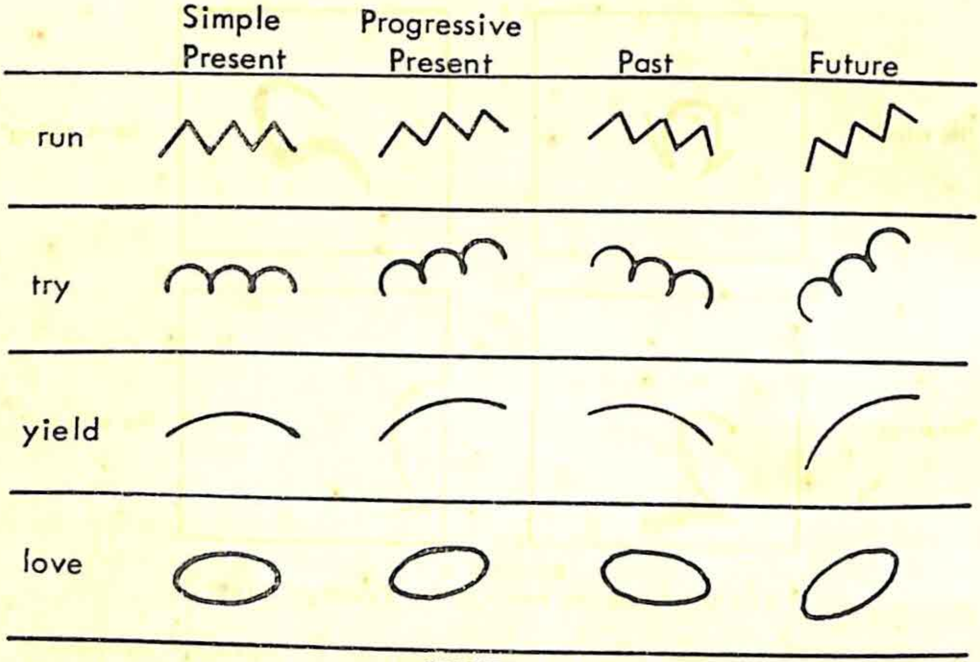


FIGURE 3
SCHEMATIC DIAGRAM OF AN IDEAL GENERAL SYSTEM: ACTIVITY QUALITY EXPRESSED BY SHAPE DIFFERENCES, TENSE DIFFERENCES EXPRESSED BY SYSTEMATIC VARIATION IN DIRECTION

of the activity interfered with the achievement of a general system of diacritica which would unambiguously designate the temporal position of an activity. However, there were striking differences in this regard. These differences in systematization were closely tied up with the degree to which the dimensions were globally fused in a subject's translation of each verbal statement.

On one extreme a subject might transform a statement into a sort of little image in which the dimensions composing the drawings were really not isolated for any specific semantic function. Insofar as the totality of a sentence meaning was depicted in such little images not composable of separate dimensions, the subject tended to lack expression of temporal systematization covering all of the sentences. The drawings of one such subject for the various tenses of "try" are given in Figure 4.

On the other extreme, one finds subjects who in their drawings sharply differentiate the various dimensions of the line medium and thus approach a systematization depicted in Figure 3. These subjects tend more or less to employ a single dimension, generally and systematically, for temporal differ-

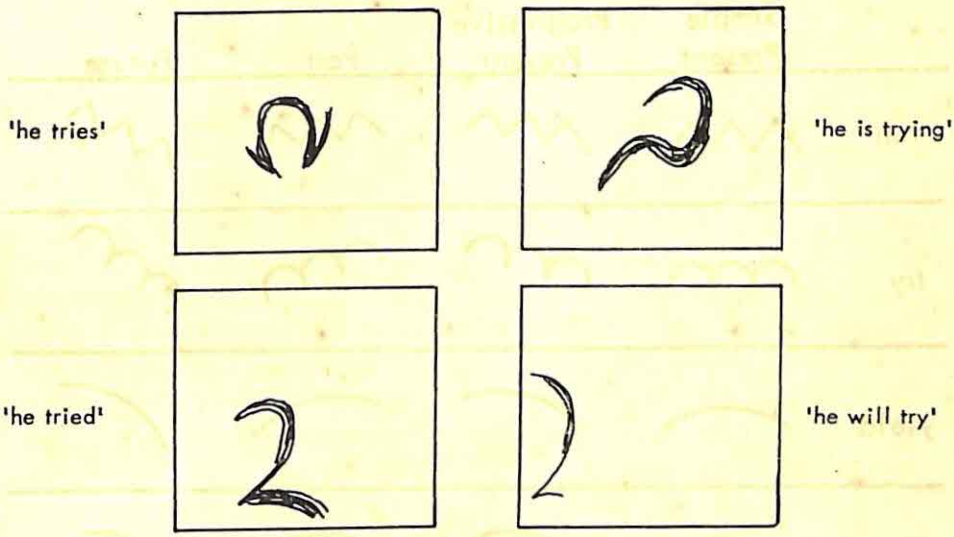


FIGURE 4
The Drawings for the Various Tenses of "Try"

entiation and ordering, using other dimensions to represent components of the activity. It may be noted that such subjects generally tend to obliterate the distinctions among the four verbal activities.

The great majority of our subjects fall in between these two extremes.

The second issue bearing on the problem of systematic expression of tense differences centers around the selection and preference of different *dimensions* of the medium itself by the individual subjects and the group.

Our analyses show quite clearly that certain dimensions of the linear medium are more generally and more typically utilized for the expression of temporal differences irrespective of the particular verbs. The rank orders for different dimensions in terms of frequency of diacritical use and the average number of subjects using a dimension for differentiation are presented in Table 2. Only the five top ranking dimensions are presented.

A complete analysis of the reasons for the markedly greater use of such dimensions as pressure and length over such dimensions as direction cannot be given at this time. However, there are at least two plausible reasons for the greater frequency of usage of certain dimensions over others; on one hand the more frequently used dimensions seem more susceptible to distinctions in *degree*; on the other hand, the dimensions less frequently used to distinguish between tenses are otherwise exploited for expressing themes of the activity *per se*.

TABLE 2
SUMMARY TABLE: DIMENSION OF DIFFERENTIATION FOR EACH VERB

Rank order	Run	Try	Yield	Love
1	Pressure	Pressure	Pressure	Pressure
2	Length	Length	Length	Above-Below Page Position
3	Speed	Above-Below Page Position	Above-Below Page Position	Length
4	Above-Below Page Position	Speed	Speed	Speed
5	Left-Right Page Position	Homogeneity/ Heterogeneity of Pressure	Homog/Heterog. Pressure	Homog/Heterog. Pressure

b. The next issue to be discussed concerns consensuality of the linear expressions of tense forms.

Examination of our data indicates that certain dimensions which are differentiated in the expressive line drawings for the different tenses are handled in relatively the same way by the subjects; e.g., insofar as direction of line differentiates past from future in our subjects, in most cases the schema for past tense is drawn more down or more to the left than the schema for future tense. In such cases, one might infer that diacritica of direction are utilized for distinguishing tense.

Now inferences such as this with regard to the relation between particular diacritica and specific tense differentiation do not appear to be sufficiently conclusive because of the following reasons:

First, as noted above, the schema is used to represent the total agent-activity-temporality unit. It is therefore quite conceivable that differences in a dimension might reflect differences in activity as much or more than in tense.

A second reason is the availability of many dimensions of the line medium for differentiation, and the subsequent exploitation of different dimensions by different subjects. In consequence, none of the particular dimensions was used for purposes of differentiation by all of the subjects; in fact, there were many dimensions in which only one or two subjects showed variation.

In order to determine whether and to what extent any isolated dimension might be utilized for purposes of discrimination of time *per se*—and to determine the potential *general* usability for purposes of communication of different diacritica, used by our subjects, a particular experimental design was introduced.

The new method which we introduced to explore the direct (as opposed to the derived) significance of dimensional variations and the degree of universality of certain types of diacritica for communication of activity-tense differences was essentially a "forced choice" technique: here we presented our subjects with two line schemata, as much as possible varied along only one dimension, and then had the subject match these schemata with two tense formations of the same verb.

For such a preliminary study we have taken some diacritica where only the barest trends were shown in the expressive line drawings of subjects; presenting these diacritica in isolation we have attempted to determine their diacritical potency for differentiating the tenses. For instance, in the line schematization study, amplitude size distinguished the simple present from the progressive present only a few times (Table 3).

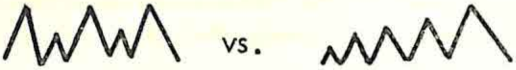
TABLE 3
NUMBER OF SUBJECTS SHOWING TENSE DIFFERENTIATION BY AMPLITUDE SIZE

	Simple present greater than present progressive	Simple present less than present progressive	Amplitude irrelevant
Run	1	3	8
Try	0	2	10
Yield	0	0	12
Love	1	2	9

It can be seen that, in most cases, amplitude size was not used by subjects as a diacriticum to distinguish the schemata for the simple present and the progressive present in different verbs; there is some tendency, however, insofar as amplitude is used, for the amplitudes of the progressive present to be drawn larger than the amplitudes of the simple present tense.

Now with the forced choice method, subjects choose the larger of two amplitudes for the progressive present over the simple present tense at a ratio of 10:1. Some other findings, using this method, follow:

(*a*). Oscillating versus increasing amplitude



is used by only 1 subject to differentiate (runs versus running) for one verb. In the forced choice method, the distribution is 11-0, present progressive: increasing; simple present: oscillating.

(*b*). For one subject, in "loving" versus "will love"—dotting locus is used as a differentiator: In the present progressive the locus of dotting is in the middle, while for the future, the locus is at the end.

> Using the forced choice method, it was found that 10 out of 11 *S*s choose ————.........———— for present progressive and ————.......... for future. The one *S* who deviated was not a native speaker of English and attributed her choice to her early experience in memorizing participial forms, i.e., stressing the "- ing" at the end. It might be noted that this *S* did not like ————..........———— for the generic future.
>
> (*c*). Although the present participle is more frequently expressed as above rather than below the simple present, this differentiation is not too sharp in the expressive technique. In the forced choice method, the distribution is 11-0, progressive present above simple present.

This preliminary experiment has been followed up by a systematic study by M. Bodansky (1), using a forced choice methodology with a wide variety of line diacritica. These experiments clearly demonstrate that some differentiations within particular dimensions, which were utilized by only a few of the subjects in our original study, actually have the potentiality for eliciting wide consensual agreement. Since there is no plausible reason for assuming that this consensuality is based on any sort of specific conditioning, the findings suggest that, on the level of primitive symbolization, differentiated components of human organismic behavior naturally, and hence commonly, can be exploited to distinguish related events. These findings thus lend empirical support to the view of those who argue that communal understanding of so-called arbitrary verbal symbols must be ultimately rooted in distinctions mediated by differentiated natural symbols common to man. It is interesting to note that our studies here bear on certain problems central to the philosophy of language from Plato's *Kratylos* to Cassirer's *Philosophy of Symbolic Forms.*

c. The last issue to be discussed within the framework of this study concerns some of the problems a subject has to face in order to arrive at a diacritical system for ordering the different tenses, transcending specific activities.

First, and basically, as we have mentioned before, the line medium invites the syncretically fused expression in a global schematic pattern of agent, action, and temporal aspects. In order to overcome the tendency to present a global picture of the total event designated by a sentence the subjects must, to a greater or lesser extent, spontaneously segregate the various dimensions of the line medium, exploiting one dimension solely for temporality. It is usually the case that a consistent segregation of the different dimensions is not achieved: either the demands for the expression of temporal features push the subjects toward the utilization of dimensions which in the earlier parts of the experiment may have been reserved for activity representation; or the demand for adequate expression of activity features may lead to the commandeering of a dimension, which may have been previously used systematically for the expression of tense differences.

We may give examples of such conflicts between activity and temporal expression with regard to a particular dimension, viz., direction.

Many subjects used vectorially downward line patterns to express the thematic content of "yields"—i.e., "giving in." In previous series of verbs ("runs," "tries") they had used vectorially upward line-drawings to indicate the "future tense." Confronted now with the problem of expressing "he will yield," various subjects resolved this conflict in different ways. In one subject, the conflict was resolved by retaining the vectorially downward line expressive of the theme, but using another dimension, that of continuity-discontinuity for expressing the future; the general use of direction for future was abandoned by the demands for thematic representation (Figure 5).

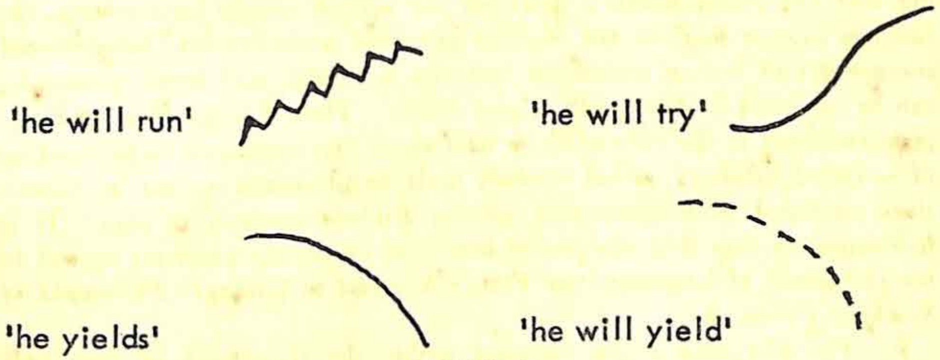


FIGURE 5
SCHEMATIC REPRESENTATIONS OF "TRYING" AND "YIELDING"

In another subject a compromise was made between the demands of activity expression and the demands of temporal expression. The subject drew "he will yield" downward, but less downward than the other tenses. The directional component of the schema was a vectorial resultant of greater downwardness to express activity and greater upwardness to express tense. The subject concomitantly interpreted "he will yield" as implying "more resistance to giving in" than does "he yields," "he is yielding," or "he yielded."

In still another subject, the demands for diacritical systematization were so strong that "he will yield" was expressed by an upward line drawing. This preserved the general use of a directional constancy for future, but required a radical transformation of the thematic content of the phrase; apparently because of the pressure of the symbolic system, "he will yield" was interpreted as meaning: "he will give some ground, but eventually will triumph."

There are several other factors inherent in the relationship of symbolic vehicle to significate which either actually or potentially work against a general and objective diacritical system: these are (*a*) the actual pluridimensionality of what appears to be a single dimension; (*b*) the plurisignificant character of a single variant of a dimension.

(*a*). With regard to the first point, that of *pluridimensionality*, it happens that a subject sometimes appears to be using a single dimension of the line medium for signification when actually he is employing several different dimensions; i.e., what to the experimenter and to most other subjects may appear as a single dimension (having only one defining characteristic) is to the subject two or more dimensions (each one defined by a single defining characteristic).

Thus, one subject drew line schematizations for "he loves," "he is loving," "he loved," and "he will love" which seemed to be differentiated clearly in terms of degrees of pressure: "he loved"—darkest; "he loves"—next darkest; "he is loving"—lighter; and finally, "he will love"—lightest. On inquiry it turned out, however, that the subject contrasted "he loves" and "he will love" in terms of the heaviness and lightness of the pressure; and contrasted "he is loving" and "he loved" in terms of the properties of softness and sharpness of the pressure. The subject, it seems clear, was actually using two dimensions rather than one, with concomitant differences in meaning. From the point of view of the decoder, there was diacritical systematization throughout for the particular verb-tense system; from the point of view of the encoder, however, there were two partial diacritical systems for the tense relations within the verb.

> It might be worthwhile to point here to an analogous problem of multidimensionality within the area of verbal language, viz. that of so-called sound symbolism. Here the sound medium functions similarly to our line medium, that is, the choice of sound forms is non-arbitrary; they depict rather than indicate that which is represented. But, just as it is true of the dimensions of the linear medium, so the dimensions of sound are multivalent rather than univalent. Experimenters on sound symbolism, usually aiming at the demonstration of general univocal relations between sound and meaning, have often overlooked the multivalent nature of sound dimensions. For instance, *i* vs. *a* may sometimes express a relationship of size ($i < a$) but may also express a

> relationship of distance ($i > a$), etc. Thus, Westermann in his study on relations of sound and meaning in the Sudan languages of West Africa has shown the multivalent character of oppositions such as "high pitch-low pitch"; this opposition, for instance, may symbolize the relation "small" versus "big," or "sharp" versus "blunt," or "energetic" versus "weak," etc.[5]

(*b*). With regard to the second point—that of *plurisignification* of a single variant of a dimension—this is a very frequent occurrence among our subjects. Since it is characteristic of the natural symbols of the line medium that they typically express fusions of time and activity, it is understandable that symbols even when sharply distinguishing tense statements may refer to quite different semantic aspects of the global temporal-activity unit.

This leads to a difficulty in semantic systematization which can be considered under two heads. *First*, variations in a line dimension do not in and of themselves indicate which of the range of semantic meanings they signify; as is illustrated below, we cannot tell from a particular pressure whether a property of the agent, a characteristic of the activity, a judgment of the observer, or time *per se* is intended. A subject may, therefore, differentiate two tenses through two contrasting modulations of a certain dimension, whereby one of the modulations may refer to one semantic class, while the other may refer to quite another semantic class. Thus, for one subject the future and past of "tries" is distinguished at least in terms of direction as follows (Figure 6).

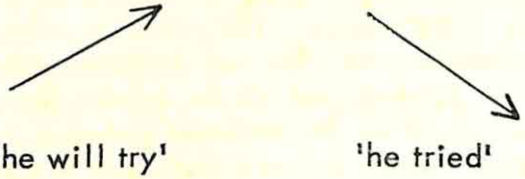


FIGURE 6
SCHEMATIC REPRESENTATION OF TWO TENSES OF "TRY"

On inquiry, it turns out that the upward vector of "he will try" refers to the aspect of "anticipation" while the downward vector of "he tried" signifies "defeat." *Second*, a variation in a dimension may simultaneously (syncretically) express more than one semantic sphere, e.g., both the "overness of activity," and the "defeat of the agent" (Figure 7).

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[5] In view of these considerations, it seems unwarranted to draw the conclusion that sound symbolism is of little importance in language, a conclusion drawn by many linguists solely on the basis of a lack of univocality between a sound vehicle and a meaning.

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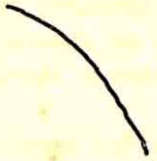


'he tried'

FIGURE 7

SCHEMATIC REPRESENTATION OF "OVERNESS OF ACTIVITY," AND "DEFEAT OF THE AGENT"

The plurisignificative character of the symbolic component may under certain circumstances not interfere with systematization; this will be the case where the various elements from different spheres of meaning are similarly representable by the vehicle (e.g., "defeat," and "overness" by downward line). However, a system of this character is always threatened by conflict. To illustrate, there was no problem for one subject in using vector to express both degree of "emotional involvement of agent" and "overness of activity." In the past of "he ran," "agent not involved" and "overness," are both expressed downwardly; thus, "he ran" is downward— perhaps more downward than it would be if only "overness" or the "non-involvement of the agent" singly were expressed. The same subject had no difficulty in expressing "he will run" upward because it referred to "more emotional involvement" of agent and also expressed "futurity." An inevitable point of conflict would arise for this subject if he were obliged to express by vectorial modulation "he,—with little emotional involvement, will run." He then would have to reconcile the downward vector of low involvement with the upward vector of futurity.

D. SUMMARY AND RESTATEMENT

In this concluding section, we shall sum up and restate the general lines of our thinking. The main theme of the present paper has centered around the problem of expressions of experience, and the significance of different media of expression for the differentiation and systematization of our transactions with the world. Our treatment of these problems may be summarized by introducing and elaborating the general concept of "rotation."

Two types of "rotation" may be distinguished. One may speak of *vehicular* or *symbolic rotation* if during an attempt to express oneself adequately one shifts from one medium to another(e.g., from verbal to gesture) or from one dimension of a medium to another dimension (e.g., from pressure to shape or direction), without changing the meaning. One may speak about *semantic rotation* when, in an attempt to express oneself, one shifts from one meaning to another, without change in the apprehension of the vehicle.

Now it is our basic assumption that rotations of either vehicles *per se* or meanings *per se* are never actualized, i.e., we assert that a change from one medium to another ("transformation") or a change from one dimension of the same medium to another ("translation") necessarily entails change in meaning; and conversely, that shifts in meaning entail shifts in the apprehension of the vehicle.

This thesis is related to the neo-Humboldtian views of E. Sapir, B. L. Whorf, and D. D. Lee (4). However, whereas these authors, to a great extent, have identified the totality of mediating devices with the verbal code, for us, the verbal linguistic medium is only one medium among many for the organization and expression of experience: there are, it seems clear, media for the organization of experience, which are below the level of verbal codification and which, because they are close to organismic activity are, from the point of view of developmental psychology, at the root of verbal language usage.

If one wishes to examine the general thesis of the relation of symbolic media to the organization and expression of experience, one must, as we have tried here, somehow get closer to this preverbal level of mediation than language alone permits.

As suggested above, the line medium is a relatively primitive one: it is not pulled by the demands of conventionality and precise comprehensibility; it is a natural medium, one that can be used analogically to depict apprehended experiences of the organism in its environment. These characteristics of the line language seem to us to underlie the fact that our subjects, in transforming verbal statements which in the English language code are comprised of separate expressions of relatively circumscribed meanings, typically express in their line drawings, fusions of agent-activity-object (cf. first study) and fusions of activity and time (cf. second study). In the former case, this often leads to a change in properties of the agent, or properties of a verbal activity, as a function of changing objects; in the latter case, it leads to conceptions of time in terms of variations in the properties and aspects of the activity. These data suggest that even in subjects capable of using more advanced categories of cognition, a primitive medium is conducive to more primitive forms of cognition.

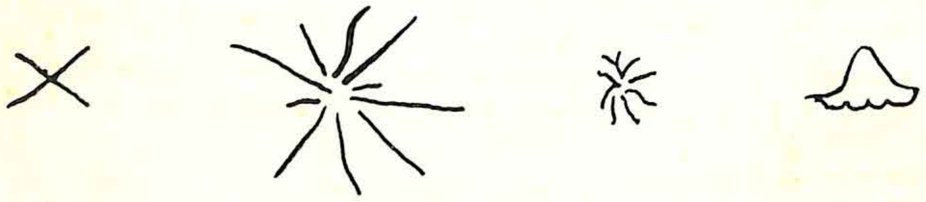
To reiterate, in expressing the codification of experience on one level of mediation in terms of another level of mediation, a new organization of the experience necessarily occurs; thus, expression through verbal language and expression through gesture language or through "behavior" are different forms of mediated experience with concomitant differences in meanings. A new medium, we believe, involves the rotation of the totality of a hypothetical experience in the process of formation until in some way the medium molds the experience in terms of its own immanent properties.

Thus far we have talked of the problem of rotation in a radical sense, viz., transformation from one medium to another. We may now touch briefly upon *vehicular rotation* within a medium. Our data from the "tense study" show that subjects frequently shift from one dimension of differentiation to another for the linear expression of temporal differences (e.g., pressure to distinguish simple present and past; direction to distinguish past and future); our findings suggest that in the process of such shifting, a change in diacriticum entails the emergence of new semantic features of temporality.

This effect of change in vehicle upon change in meaning comes out strikingly in a recent experiment, carried out by M. Bodansky. One illustration from this study, originally designed to investigate rotation in the context of forced systematization, may serve to clarify the relation of vehicular rotation to meaning.

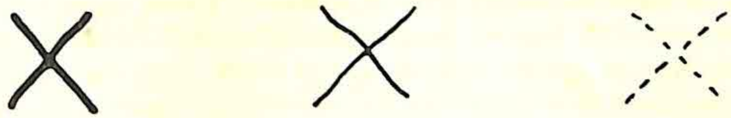
Briefly, each subject, after he had drawn line expressions for the different tense forms of several verbs, was asked to schematize the tense-verb statements again with the limitation that the same shape must be used to express all the tenses within a particular activity. For instance, one subject, for the four phrases "to fight," "he fights," "he is fighting," "he fought," drew first the schemata indicated in Figure 8.

Under the limiting conditions of constancy, this subject using × as the basic form, drew the schemata for "he fights," "he is fighting," and "he fought" (Figure 9).



'to fight' 'he fights' 'he is fighting' 'he fought'

FIGURE 8
SCHEMATIC REPRESENTATION OF THE VARIOUS TENSES OF "FIGHTING"



'he fights' **'he is fighting'** **'he fought'**

FIGURE 9
TENSES OF "FIGHTING" UNDER LIMITING CONDITIONS OF SHAPE CONSTANCY

On inquiry, the subject contrasted the meanings of schemata for "he fights," "he is fighting," and "he fought" in the two approaches as follows:

For the first versus the second drawing of "he is fighting" the subject remarked: "I prefer the first because it is less definite; it's hard to make this shape × indefinite." Thus the change to crossed lines forced the submergence of definiteness as the basis for degree of immediacy in the semantic differentiation of simple present and progressive present; it is now "relative strength" (less pressure in PP) rather than "definiteness" which mediate the differences in "immediacy" between the two tenses.

With regard to the first and second drawings of "he fought" the subject remarked: "The first is really the state of the person, the state he is left in after the fight (a shapeless, sagging heap) . . . it implies a lot about the person that the second doesn't. The second says more about the conflict itself . . . it's the shadow of former conflict." Here again, different vehicles entail differences in expressed meaning and also changes in the ways related meanings are differentiated from each other (semantic opposition).

The notion of rotation suggests many problems equally important for symbolization in general and linguistic encoding in particular; we are now in the process of exploring some of these problems by a variety of experimental methods.

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BEHAVIOR IN A FREE CHOICE MULTIPLE PATH ELIMINATION PROBLEM*

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A. PURPOSE

Crannell reported that a ". . . majority of rats were found capable of solving a four-path elimination problem in which the order of elimination was not controlled in any way by the experimenter" (1).

The primary purpose of the investigation now reported was to determine whether the rat develops stereotyped behavior in a "free" choice multiple path elimination problem when permitted to run beyond the criterion trials.

Stereotyped behavior in this situation refers to the selection of paths by the rat in an invariable sequence on successive trials; the word "free" refers to the fact that the sequence of selection of paths was not predetermined by the experimenter.

Tolman (3, 4) suggested and Muenzinger (2) experimentally demonstrated a direct relationship between learning efficiency and vicarious-trial-and-error (*VTE*) at a point of choice. Increased frequency of correct decision was also demonstrated to be positively correlated with increased frequency of *VTE* (2), and presumably, with increased hesitation time.

A secondary purpose of this research was to determine some of the relationships between time at a point of choice and accuracy of decision during the learning and postlearning periods on a multiple path problem.

B. METHOD

1. *Apparatus*

The apparatus consisted of four elevated pathways radiating from a circular platform 15 inches in diameter. These pathways, five feet long and

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*Submitted in March, 1956 destroyed in the fire; received again in the Editorial Office on September 28, 1956, and published immediately at Provincetown, Massachusetts. Copyright by The Journal Press.

[1] A summary of this paper was read by the senior author under the title of "Stereotypy and Variability of Behavior in a Free-Choice Multiple-Path Elimination Problem" at the Midwestern Psychological Association meeting in Columbus, Ohio, in April, 1954.

[2] The authors gratefully acknowledge the assistance of the Wayne University Computation Laboratory, and especially of Dr. Arvid Jacobson and Mr. Thomas Sucher, for generous coöperation in the statistical analysis of the data.

three inches wide, were separated from each other by 30 degrees, i.e., the four paths thus occupied a 90-degree angle. These dimensions are similar to the dimensions of Crannell's apparatus (1). Eight inches from the distal end of each pathway a vertical obstruction plate was mounted. A door in this plate normally was kept closed by a spring weak enough to allow a rat to push through easily. The door could also be locked without indication of the fact visible to the rat. A small quantity of food was provided behind each door. A tunnel just large enough for the rat to squeeze through was mounted on the circular platform in such a way that its axis bisected the angle between Runways 2 and 3, and an eight-inch platform was attached distally to the tunnel. In order to insure constancy of initial orientation, animals after being placed backwards on this starting platform were admitted to the circular choice point platform through the tunnel.

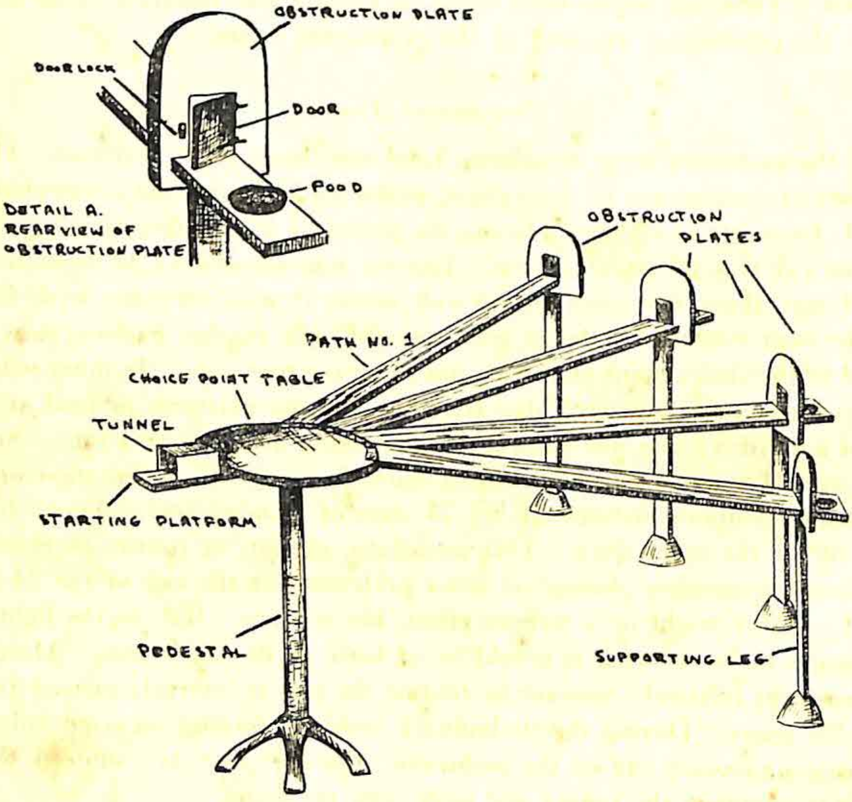

FIGURE 1

Diagram of Elevated Multiple Path Apparatus

2. *Subjects*

The subjects of this experiment were nine albino rats. Seven of these were males; two were females. All rats were experimentally naïve. In fact, although they were eight months old, they had never previously been handled. Two full weeks were spent in feeding and handling them daily, before the preliminary training of the experiment began.

3. *Preliminary Training*

All the pathways were detachable from the choice point platform. (For purposes of convenience in description, pathways are numbered consecutively, 1 to 4, from left to right.) During the period of preliminary training, only one runway was in use at a time. The rat was allowed to go through the tunnel and along that path to the end where it was rewarded with food. On the next run that pathway was removed, and another pathway was attached to the choice point platform, and so on for four runs. In other words, the rat made four trips each day from the starting platform to food at the end of a runway, only one runway position being available at a time. Since there are 24 possible permutations of four elements, the presentation order of runway positions on each of the 24 days of training was different from those of all the other days. This procedure, cannot, of course, be claimed to guarantee complete absence of order preference at the end of the 24-day period. There might be a recency effect, for instance. But, in the light of the results to be reported it would be of little or no importance. Motivation was kept relatively constant by feeding the rats at intervals varying from 22 to 26 hours. During the preliminary training, feeding occurred only at the distal or reward end of the pathways. On the first day, subjects were taught to negotiate the tunnel and push open the doors.

4. *Procedure*

Following the preliminary training, all four pathways remained simultaneously attached to the circular platform. The subject was then placed on a small platform at the entrance to the tunnel.

Hesitation time (1), also called decision time and choice point time, was measured as the interval from the time the animal's four feet emerged from the tunnel to the time the animal ran 12 inches along any path. The animals occasionally vacillated from path to path within that distance. If a distance of more than 12 inches had been used as a criterion, running time rather than hesitation time might have been measured. This criterion of a choice proved adequate, for if an animal traversed as far as 12 inches along a path, it almost invariably continued to the end. (Decision time was measured to the nearest half-second.)

If the animal chose correctly it received food at the end of the pathway. If it chose incorrectly it was blocked from the food by the locked door. In either case the animal was returned manually to the starting platform at the tunnel entrance. Each door was locked after the animal had run to the end and received its reward. The solution to the problem was to choose four different paths in any order on four successive runs. (Each time a subject chose a particular pathway after having chosen it previously, it would find the door locked and the choice would be tabulated as an error.) The animal was allowed from 10 to 20 seconds in which to eat its food, at the end of each of the first three runs. After the last run it was allowed three minutes, and then was transferred to a separate table for at least 20 minutes more. A day's *trial* consisted of as many runs as necessary for the animal to make four correct choices; in other words, the number of runs in a trial was equal to four correct choices in addition to any incorrect choices.

At the end of the first run the chance of a correct choice is .75 if choices are made wholly at random. Assuming that it chooses appropriately, the chance of a correct new choice becomes .5, and the chance that the last choice is correct is .25. Therefore, the chance of all choices being correct is $1.00 \times .75 \times .5 \times .25$ or .094. The probability of performing the task to perfection on four successive days is .000077. In other words, since the probability of behaving in such a manner as a result of random choices is exceedingly remote, this was chosen as our criterion of learning: *Choosing four successively different paths on each of four successive trials.*

C. RESULTS

1. *Learning Rate*

All of the subjects attained the criterion of learning. The learning curve in terms of errors committed is negatively accelerated.

Individual variability of rate of learning was large. The best learner required 19 trials to achieve the criterion; the poorest 154 trials; the mean number of trials for learning was 74.6 trials (see Table 1). The mean number of errors committed throughout the experiment was 209.3 of which 163.4 errors were committed before the criterion was attained and 45.9 afterward. Otherwise stated, postcriterion errors averaged .5 per trial; precriterion errors, 2.2 per trial.

TABLE 1

LEARNING EFFICIENCY AND ADEQUACY OF THE LEARNING CRITERION

Measure	No. of days required for learning	Prelearning errors	Postlearning errors	Prelearning mean no. of errors per trial	Postlearning mean no. of errors per trial
Range	19-154	42-299	10-86	1.9-2.8	.2-1.7
Mean	74.6	163.4	45.9	2.2	.5

2. *Time of Correct and Incorrect Choices*

Correct choices were made more rapidly on the average than incorrect choices.

It is also apparent (from the results presented in Table 2) that pre-criterion choices, both correct and incorrect, were made in less time than post-criterion choices.

TABLE 2

HESITATION TIME IN SECONDS

Hesitation time	Prelearning period	Postlearning period	Total
Mean correct hesitation time	5.6	8.3	7.0
Mean incorrect hesitation time	7.6	9.9	8.1
Mean total hesitation time	6.3	8.8	7.4

3. *Comparison of Prelearning and Postlearning Decision Time*

Further analysis of hesitation time discloses that the first two correct choices, for both the prelearning and the postlearning periods, are made more rapidly, on the average, than the last two correct choices.

These data also indicate that correct decisions, whether first, second, third, or fourth, tend to be made more rapidly during the prelearning than during the postlearning period. Since the distributions of time scores were so greatly skewed, the standard deviations are very large. However, by arbitrarily classifying correct decisions as those performed in eight seconds or less and those requiring more than eight seconds for prelearning and for postlearning periods, a fourfold table was constructed which yielded a chi square of 6.45. This indicates that these differences were significant at between the .01 and .02 levels of confidence.

TABLE 3
CORRECT HESITATION TIME

Item	Prelearning	Postlearning	Total
First correct choice			
Mean	4.9	7.5	6.3
Range	1.0- 76.0	1.0-120.0	1.0-120.0
Second correct choice			
Mean	4.5	7.0	5.8
Range	1.0- 60.0	1.0-101.0	1.0-101.0
Third correct choice			
Mean	5.3	8.2	6.8
Range	1.0-109.0	1.0- 80.0	1.0-109.0
Fourth correct choice			
Mean	7.8	10.4	9.2
Range	1.0-420.0	1.0-153.0	1.0-420.0

4. *Details of Incorrect Decision Time*

Because of the nature of the problem, the first and last runs of a given day's trial are necessarily correct. (In making the last run only one particular path of the four is correct, and the animal must select that path to terminate the day's trial.) The mean time of first choices was 6.3 seconds; that of fourth choices, 9.2, an increase of 46 per cent.

TABLE 4
INCORRECT DECISION TIME IN SECONDS

Item	Prelearning	Postlearning	Total
No. of errors occurring after one correct choice	48	9	57
Mean incorrect decision time	5.1	7.3	5.5
Range	1.0- 30.0	1.0-19.0	1.0- 30.0
No. of errors occurring after two correct choices	229	50	279
Mean incorrect decision time	7.2	10.7	7.8
Range	1.0- 83.0	1.5-73.0	1.0- 83.0
No. of errors occurring after three correct choices	1,195	354	1,549
Mean incorrect decision time	7.8	9.9	8.2
Range	1.0-135.0	1.0-82.0	1.0-135.0

Further analysis of incorrect decision data reveals that few incorrect choices were made after one correct choice, 57, more after two correct choices, 279, and a relatively large number after three correct choices, 1,549.

The time of an incorrect choice tended to increase with the number of previous correct choices made during the trial. Likewise, in each case, whether the error occurred after one, two, or three correct choices, decisions were made more rapidly during the prelearning period than during the postlearning period. Since the distribution of time scores was so greatly skewed, the standard deviations were very large. However, a fourfold table, constructed as described above, yielded a chi square of 3.45, with significance between the .05 and .10 levels of confidence.

5. *Path Preferences*

Stereotyped behavior in the sense that the animal rigidly repeated the same sequence of paths (such as 1-2-3-4 or 4-3-2-1 or 2-3-1-4 or any other specific order) on successive trials did not develop. Only extremely rarely was any particular pattern repeated on two successive trials; the same errorless pattern once occurred on three successive days and never on four successive days. On the contrary, animals frequently performed for 10, 12, or more successive days without error, varying their path sequences from trial to trial.

However, preferences for certain paths appeared.

TABLE 5

PATH PREFERENCES ON THE FIRST AND LAST CHOICES IN TERMS OF PERCENTAGES

	Prelearning Path No.				Postlearning Path No.				Total Path No.			
Preference	1	2	3	4	1	2	3	4	1	2	3	4
First choice preference	11	41	40	8	3	29	54	14	7	35	47	11
Last choice preference	20	34	34	12	26	38	20	16	23	36	27	14

On the first choice, there was a preference for the inner pathways rather than the outer ones. Of the first choices, 82 per cent were for Paths 2 and 3.

The last choice preference, though not as strong as the first choice preference, was also in favor of the inner paths, 2 and 3. A trend existed to select the outer paths on intermediate runs, i.e., runs after the first choice and before the last. In other words there was a tendency to avoid the peripheral paths, 1 and 4, as first and last choices.

6. *Choice Sequences—Stereotypy and Variability*

A superficial examination of the data suggested that not only was there no stereotypy, or predominant preference for some particular sequence, but that the preferred sequences were those in which each successive choice differed as much as possible from the preceding one. However, it was not clear that the sequences chosen were not random sequences. In order to determine whether animals chose sequences in which successive runs tended to diverge from each other maximally, a semi-arbitrary procedure was employed for appraising each possible response pattern in terms of a divergence value. A chart of the 24 behavioral patterns, i.e., the 24 possible permutations of four correct runs, was constructed and a "divergence" score assigned to each pattern according to the following rationale: If the contiguous paths in a pattern were selected successively, there is a divergence of three units. For example, if after choosing Path 1, the animal chooses Path 2, that is but one unit away and therefore has a divergence value of one; if it then selects Path 3, that too has a divergence of one; and if Path 4 is next selected, there is another divergence of one. Hence, the pattern 1234 (and this would apply to 4321 as well) has a total divergence of three units.

As another example, 4-1-3-2: Choosing Path 1 after 4, in the sequence 4-1-3-2, constitutes a divergence of three units; Path 3 diverges by two units from Path 1; and the succession 3-2 yields another (one more unit of divergence). Thus, there is a divergence value of six units for the path sequence 4132.

TABLE 6
SEQUENCES OF CORRECT RESPONSES FOR ALL SUBJECTS DURING 160 TRIALS

Units of divergence	3 Units	4 Units	5 Units	6 Units	7 Units
Specific sequences of paths	(1234 and 4321)	(2134, 1243, 4312 and 3421)	(3124, 4123, 2143, 1324 3214, 4213, 1342, 2341, 4231, 3412, 1432, and 2431)	(4132, 2314, 3241 and 1423)	(3142 and 2413)
Absolute no. of choices	17	110	620	238	455
Weighting factor	½	¼	1/12	¼	½
Degree of preference	8.5	27.5	51.7	59.5	227.5

A trial for an animal on any day falls into one of the 24 patterns each of which is classifiable in terms of a divergence score, which, as defined, has a range of 3 to 7.

The absolute numbers of possible patterns varied from one divergence category to another, i.e., there were only two possible patterns which would yield a divergence of three units, four possibilities for a divergence score of four units, 12 possibilities for a score of five units, and so on. It is, therefore, necessary to give appropriate consideration to the chance factor.

Since there were two chances (of the 24 possible combinations) of running a pattern with a divergence of three units, the total number of choices with divergences of three was divided by a weighting factor, 2, in order to obtain a mean preference for patterns with a divergence of three. Since there were 12 possibilities of a pattern with a divergence value of five, the total number of choices with a divergence of five was divided by a weighting factor of 12, in order to obtain the mean preference score for patterns with a divergence of five. The other groups are treated similarly. In Table 6, sequences are grouped in terms of their divergence values and the frequency of choice for each group indicated.

Chi-square technique was employed to determine whether the sequence could be regarded as the result of random choices. The findings suggest a definite increasingly strong preference for the sequences having largest divergence scores, with the strongest preference for the succession of pathways having the maximum divergence, seven units.

7. *Patterns of Divergence*

Further analysis of divergence was possible by grouping the patterns into pairs, each having the same first two choices (see Table 7).

TABLE 7

PATTERNS OF RESPONSE PAIRED ACCORDING TO IDENTICAL CHOICES ON THE FIRST TWO RUNS OF A TRIAL

	A. 1-2 Pattern		*B. 1-3 Pattern*		*C. 1-4 Pattern*		*D. 2-1 Pattern*	
The pattern	1234	1243	1324	1342	1432	1423	2134	2143
Divergence value	3	4	5	5	5	6	4	5
No. of responses	2	5	14	19	30	29	21	42
	E. 2-3 Pattern		*F. 2-4 Pattern*		*G. 3-1 Pattern*		*H. 3-2 Pattern*	
The pattern	2341	2314	2431	2413	3124	3142	3214	3241
Divergence value	5	6	5	7	5	7	5	6
No. of responses	46	70	73	245	49	210	52	103
	I. 3-4 Pattern		*J. 4-1 Pattern*		*K. 4-2 Pattern*		*L. 4-3 Pattern*	
The pattern	3421	3412	4123	4132	4231	4213	4321	4312
Divergence value	4	5	5	6	5	5	3	4
No. of responses	65	204	15	36	31	45	15	19

Since the last two members of paired sequences (in this analysis) could not be in the same order, it was possible, in fact likely, that the divergence scores for each pair would be different. From an inspection of these differences and the frequencies of their preference, it might be permissible to determine the consistency of operation for the maximum divergence preference aforementioned. Such an inspection (with the exception of Patterns C 1-4) provides further corroboration regarding the statistical preference, already cited, for the most divergent pattern.

8. *Preferences for Divergence Sequences*

It becomes necessary at this point to anticipate in part the interpretations to be made later. Since the last choice is automatically correct *if the animal has learned completely that no previous choice is to be repeated*, the degree of divergence between the third and the fourth run is automatically determined. The possibility exists that animals might be making their first three runs in a "random" manner and that whatever divergence scores were obtained depended upon the fact that the animal was forced to select the remaining noncontiguous path on the last trial. In order to check this possibility, divergence preferences on the basis of the first three runs were tabulated. The summary data are found in Table 8. The results clearly indicate that the same divergence tendency indicated for the total pattern of runs is also apparent on the first three runs of the pattern. Further, comparison of divergence scores on the first three runs when the initial choice was for one of the medial paths, with scores when the initial choice was for one of the peripheral paths (see Table 8), also support the generalization that the animals preferred path sequences with the greatest divergence values.

D. Discussion

1. *Confirmation of Crannell's Finding*

Crannell's finding that rats were ". . . capable of solving a four-path elimination problem in which the order of elimination was not controlled in any way by the experimenter" was confirmed, since all subjects met the criterion of learning.

2. *Some Unusual Data*

A number of the findings of this research were unusual and challenge theoretical consideration. Among these were the findings that:

a. Hesitation times preceding erroneous choices were longer than hesitation times preceding correct choices.

b. Hesitation times during the prelearning period, preceding both correct and incorrect responses, were *shorter* than the corresponding hesitation times during the postlearning period.

c. None of the subjects developed a stereotyped sequence of choices in solving the problem. The pattern of runs varied radically from trial to

TABLE 8
PATTERNS OF RESPONSE IN TERMS OF DIVERGENCE SCORES ON THE FIRST THREE RUNS

Units of Divergence							
Two		Three		Four		Five	
Path-sequence	No. of responses	Path-sequence	No. of responses	Path-sequence	No. of responses	Path-sequence	No. of responses
A. Patterns of response in terms of divergence scores on the first three runs regardless of initial preference							
1234	2	1243	5	1432	30	1423	29
2341	46	1324	14	2143	42	2413	245
3214	52	1342	19	3412	204	3142	210
4321	15	2134	21	413	15	4132	36
		2314	70				
		2431	73				
		3124	49				
		3241	103				
		3421	65				
		4231	31				
		4312	19				
		4213	45				
Total	115		514		291		520
Weighting factor	¼		1/12		¼		¼
Degree of preference	28.8		42.8		72.8		130
B. Patterns of response in terms of divergence scores on the first three runs when the initial preference is for one of the peripheral paths							
1234	2	1243	5	1432	30	1423	29
4321	15	1324	14	4123	15	4132	36
		1342	19				
		4231	31				
		4213	45				
		4312	19				
Total	17		133		45		65
Weighting factor	½		1/6		½		½
Degree of preference	8.5		22.2		22.5		32.5
C. Patterns of response in terms of divergence scores on the first three runs when the initial preference is for one of the medial paths							
2341	46	2134	21	3143	42	2413	245
3214	52	2314	70	3412	204	3142	210
		2431	73				
		3124	49				
		3241	103				
		3421	65				
Total	98		381		246		455
Weighting factor	½		1/6		½		1/6
Degree of preference	49		63.5		123		227.5

trial, even though most of the animals were observed for a considerable period following achievement of the learning criterion.

d. A conspicuous preference for high divergence (in the sense that we have defined "divergence") existed.

3. *Preference for the Two Middle Paths on the Initial Run*

That the first run preference is for one of the two middle paths is not difficult to understand. The entrance tunnel was so placed that the emerging animal was oriented toward these two paths.

4. *Paradoxical Features of the Time Data*

Muenzinger (2) found that the ". . . higher the frequency of *VTE*, the greater the learning efficiency of the animal." The fact that in the present research hesitation time increased as learning progressed is not inconsistent with Muenzinger's finding.

Hesitations prior to incorrect decisions were longer than those preceding correct decisions. Furthermore, hesitation times preceding both correct and incorrect choices were longer following achievement of the learning criterion than before. This is paradoxical. For rote learning, it is reasonable to expect more and more rapid performance as learning progresses. As a matter of fact, for such learning, increasing speed of performance or decreasing latency is usually regarded as an index of degree of learning. It appears, therefore, that what these rats have learned is not to be identified with what rats learn in the usual learning experiment.

Of course, there may be a question about the degree of relevance of the choice times. During the period of hesitation the animals may sniff, scratch themselves, stretch, etc., and the time consumed in such incidental behavior may be irrelevant to the main performance. But this only raises a further question: Why did these rats take time out for irrelevant behavior, instead of getting on with the main business, and why did such "irrelevant" behavior occur more extensively during incorrect choices than during correct choices?

5. *A Theoretical Perspective*

As a consideration preliminary to any interpretation of the results of this investigation we would point to the *negative* character of the learning. The rat "learns" *not* to repeat traversing any runway previously utilized in the day's "trial." Learning *not* to do one thing is in general indistinguishable from learning to do something else in a situation providing only two alternatives. But the subjects of this experiment were confronted with a situation providing four alternatives. Learning *not* to follow Path 1 a second time is not equivalent to learning to follow Path 2; it is at most equivalent to learning to take 2, 3, or 4. But another aspect of the matter now appears. The rat does not take 2, 3, or 4 at random, but exhibits a strong preference for 4, or, at least, 3. Moreover, the rat's performance is not guided by a specific "cue" as in the visual discrimination learning case. The "cues" in our situation, whatever they may be, if indeed one can speak justifiably of "cues" (in the plural) remain the same throughout the rat's entire performance, unless appeal is made to the improbable hypothesis that some intensification of the odor of a pathway results from its recent utilization by the rat.

Suppose now the rat has utilized Runway 1; dominated by the maximum divergence principle (i.e., tendency), he now follows Pathway 4. Having done so the maximum divergence principle requires it to take Pathway 1 next. But this is contradicted by the no-repetition principle. It achieves a compromise between the two and chooses Runway 2. Now it faces an even more violent conflict of principles, because 3 differs from 2 to a minimum degree only. The principle of non-repetition prevails and the rat achieves an "errorless" performance. In other words, at least two principles at times *apparently* contradictory are necessary to account for the performance of these animals. We say "apparently" because a genuine contradiction cannot be allowed to stand; a third principle must be introduced. It must be a principle for deriving a resultant of the consequences of the first two principles. Thus we are offering a configurational interpretation; the rat is performing in the presence of the entire situation, not merely a part of it; and it must, in a certain sense, be supplying its own "cues" in the form of shifts in successive stages of performance, of what in human phenomenology would be referred to as figure ground relations. The learning which has occurred is thus supposed to be the acquisition of the possibility of such shifts in conformity with the organized interaction of the principles of non-repetition and maximum divergence.

E. SUMMARY

Nine albino rats were tested daily for 160 days on a four-choice multiple-path problem in which the order of path elimination was not controlled in any way by the experimenter. The criterion of learning was choosing four successively different paths on each of four consecutive days.

1. All subjects solved the free-choice multiple-path problem by attaining the learning criterion in from 19 to 154 days.

2. Correct choices were made more rapidly than incorrect choices. Both correct and incorrect choices were made more rapidly before the learning criterion was attained than after.

3. Hesitation time was shorter on the first two runs of a given day's trial than on the last two.

4. Stereotyped behavior in the sense that the animal rigidly repeated the same sequence of paths on successive trials did not develop. Rather variability in the pattern of response on successive trials was characteristic of the subjects.

5. There appears to exist a strong preference for subjects to select on successive runs, pathways which diverge most from each other, i.e., a preference for selecting a succession of pathways in which each correct choice diverged maximally in space from the correct path previously chosen.

The fact that learning occurred for this kind of problem supports previously reported data. Certain response and time data are most unusual. The preference for the middle path on initial runs is probably due to the orientation of these two paths to the entrance tunnel. There is a strong suggestion that the critical cues controlling the behavior were implicit. A suggestion toward the interpretation of the data indicating an absence of stereotypy is made.

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DIFFERENTIATION BETWEEN INTROVERT-EXTRAVERT TYPES BY RORSCHACH METHOD AS COMPARED WITH OTHER METHODS*

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A. INTRODUCTION

As Klopfer points out (2, p. 223): "The introversion-extraversion problem, . . . forms the core of Rorschach's own personality theory and appears over and over again in '*Psychodiagnostik*' under the untranslatable heading 'erlebnistyp.' "

Erlebnistyp or "experience balance," as it is commonly termed, is based on the proportion between the number of M (human responses), and the sum of C (color responses). This experience is said to indicate the subject's basic personality in the Rorschach test. Rorschach wrote (5, p. 181):

> The relationship between movement and color factors represents the relation between introversion, the faculty of doing "innerwork," and extratension, the faculty of turning to the outer world, in the subject. . . . This relationship may be formulated in terms of the "experience type."

These terms (8, pp. 21-22), as Burt points out, were borrowed from Jung's classifications, and "Rorschach's extratension . . . is in no way distinctive of Jung's extraversion" (1). Klopfer (2, p. 220) uses the terms "introvert" and "extrovert." Introverts, as he writes, are "people who are predominantly prompted from within," while extraverts are "people who are predominantly stimulated from without." Piotrowski describes the two personality types in these words:

> In general, the greater the introversion of a patient, i.e., the greater the superiority of his movement over his color responses in absolute and relative numbers, the stronger is the patient's tendency to restrain overt actions and to withdraw emotional rapport with the environment . . . (4, p. 24). The stronger the dominance of the CR over the M, the stronger "the urge to live in the world outside oneself, the more unstable the affective reactions, and the more restless the motility" (4, p. 25).

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Burt does not accept Rorschach's classification based on the contrast between movement and color and gives form and color as the factors more likely to distinguish between the two personality types. In his most far reaching critique, Burt suggests that "where the Rorschach hypotheses depart from the better-established theories, *the Rorschach hypotheses should be rejected*" (1).

Burt's criticism seems to find confirmation in a study of Thornton and Guilford (7) who correlated Rorschach movement and color categories (number of M, M%, number of C, C%, and M:C) with the Nebraska Personality Inventory scores, measuring introversion-extraversion. The results were negative as no significant correlation was found between the two tests. Sen (6) also found no significant correlation between the introversion-extraversion assessed by the Rorschach traditional method and the judges' ratings. Instead, her table shows a high positive correlation between the judges' ratings and Burt's method of Rorschach scoring by content (r = .540). Here, the same problem will be investigated with regard to the results obtained for the group Rorschach method.

B. Test and Procedure

The experience balance proportion, M:Sum C, was calculated for each subject. On the introversive side, each movement response, M, was given the value of 1. On the extraversive side, each color pure response, C, was attributed the value of 1½, each color dominated response, CF, the value of 1, and each form dominated response, FC, the value of ½. The following formula was used:

$$\frac{\text{Sum of C}}{\text{Number of M} + \text{Sum of C}} \times 100 = \text{Sum C\%}$$

Thus, 50 per cent of C responses represented a middle point between introversive and extraversive sides. Scores below 50 per cent may be considered as introversive and scores above 50 per cent may be considered as extraversive. Also, F% category (per cent of form responses) as substituted for M, was applied in the present investigation.

An introversion-extraversion questionnaire devised by Neymann and Kohlstedt (3) was used as one of the criteria. This questionnaire consisted of 50 equally weighted items. The subject had three choices and could answer each question by encircling "Yes" or "No" or "?". Introversion-extraversion proportion was calculated in the same way as it was calculated before for Rorschach movement and color categories. Thus, scores over 50 per cent were considered as extraversive and below 50 per cent as introversive. In a record where there was an equal weight of introversion and extraversion responses, this measure equalled 50 per cent, in one with no introversive and only extraversive responses, it equalled 100 per cent.

The reports made by the educational and military authorities were used as the second external criterion. These reports were based upon a three-point rating scale, namely, extraversive, ambiversive, and introversive type. The judges knew the meaning of the psychological types in question, but in order to achieve uniformity they were carefully instructed regarding the nature of introversion and extraversion. The testees were assessed on the basis of day-to-day observations of their military and boarding school life.

C. SUBJECTS

Group Rorschach test was given to 286 adults, 194 men and 92 women. They belonged to one of nine groups, six male groups and three female groups.

Group I consisted of 23 members of the Air Force. The ages ranged from 19 to 38 with an average of 29.8 years. The average *IQ*[1] was 97. The average educational background was 7.6 grade. All of them were mechanics and electricians in civilian life.

Group II consisted of 36 members of the Signal Corps. The ages ranged from 21 to 46 with an average of 27.4 years. The average *IQ* was 106. The average educational background was 8.3 grade. Among them were 19 mechanics and electricians, four regular army non-commissioned officers, three clerks, one forester, one merchant, and 18 without occupation.

Group III consisted of 30 members of the Women's Auxiliary Navy Service. The ages ranged from 19 to 29 with an average of 21.3 years. The average *IQ* was 95. The average educational background was 5.1 grade. These testees had no occupations in civilian life.

Group IV consisted of 42 male engineering students whose ages ranged from 20 to 33 with an average of 24.6 years. The average *IQ* was 130.

Group V consisted of 23 members of the Women's Auxiliary Air Force Service. The ages ranged from 25 to 43 with an average of 25.0 years. The average educational background was 11.6 grade. Among them were three teachers, one regular army officer, one photographer, one chemist, one clerk, and 16 had no occupations.

Group VI consisted of 24 male primary school teachers. The ages ranged from 22 to 44 with an average of 33.4 years. The average *IQ* was 109. The average educational background was teachers' college.

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[1] Intelligence Quotients were computed according to Terman-Merril Scale.

Group VII consisted of 28 members of the Air Force. The ages ranged from 23 to 37 with an average of 32.4 years. The average *IQ* was 116 and the average educational background was 9.8 grade. All of them were mechanics and electricians in civilian life.

Group VIII consisted of 41 male contestants for university scholarships in engineering. The ages ranged from 18 to 32 with an average age of 24.8 years. The average *IQ* was 129. All of them were junior college graduates and college students.

Group IX consisted of 39 female students of junior college whose ages ranged from 16 to 24 with an average of 19.7 years. The average *IQ* was 120.

The introversion-extraversion questionnaire was given to 88 of these subjects, namely, to 36 men (Group II) and 52 women (Groups III and IX). External judges' assessments concerning introversion-extraversion were also obtained for the same subjects.

D. Results and Discussion

The distribution of Rorschach categories M, F%, and C (8, pp. 92-96) show that the mean percentage of M for men and women is 11.45 and 9.89, with standard deviations of 7.26 and 7.20 respectively. It also shows that the mean of F% for men and women is 33.87 and 40.09, with standard deviations of 15.21 and 15.39 respectively. The mean of Sum of C% for men is 12.62 and for women 10.86, and respective standard deviations are 8.22 and 7.15. These percentages show that men exceeded women in human movement and color responses but were significantly inferior in pure form responses.

Distribution of responses according to introversion-extraversion balance shows that among men the color was predominant over the human movement, while with women the proportion of two introversion-extraversion components was equal. As a possible substitute for the M category, form was contrasted to color. Here, color (extraversion) predominance was marked by scores over the respective means, and form (introversion) predominance below the means. It shows that men exceeded women in color, while women gave more form responses than men. None of the curves drawn for each component and their proportions represent a normal distribution. Nevertheless, the percentage of form and the percentage of color to form ratio more nearly approaches the normal curve.

As to the agreement between Rorschach introversion-extraversion ratio and external criteria, Table 1 shows that in 30.7 per cent of cases, that is, 27 out of 88 subjects, there was a complete agreement of assessment between the Rorschach M:Sum C proportion and external judges.[2] There was a greater agreement (37.5%, that is 33 cases) between the sum C:F% proportion and ratings of judges.[3] However, the agreement was too low in both cases for valid assessment of introvert and extravert types by the group Rorschach procedure. Table 1 also indicates that there is much higher degree of agreement between introversion-extraversion questionnaire and the ratings of judges. Here complete agreement of assessment occurred in 68 cases, that is, 77.3 per cent of the total sample.[4]

TABLE 1

DEGREE OF AGREEMENT BETWEEN JUDGES' RATINGS AND TESTS

Rorschach category proportion	Group II (36)		Group III (30)		Group IX (22)		Total (88)	
	No. of subjects	%	No. of subjects	%	No. of subjects	%	No. of subjects	%
(Sum C:M)%	5	13.9	13	43.3	9	40.9	27	30.7*
(Sum C:F)%	9	25.0	12	40.0	11	50.0	33	37.5†
Introversion-extraversion Questionnaire	32	88.9	21	70.0	15	68.2	68	77.3‡

*Chi-square = 1.23, not significant; coefficient of contingency = .117 ± .106.

†Chi-square = 6.68, significant at .01 level; Coefficient of contingency = .266 ± .106.

‡Chi-square = 125.47, significant at .001 level; Coefficient of contingency = .766 ± .106.

Furthermore, correlation between movement to color proportion and introversion-extraversion questionnaire was found to be —.264 ± .099, while at the same time the correlation coefficient between form to color proportion and introversion-extraversion questionnaire was .171 ± .103. One would expect, as Burt (1) points out, "a negative correlation between interest in movement and in color," if these two are to reflect introversion-extraversion balance; whereas, in the present study, the correlation coefficients between movement and color categories were —.127 ± .070 for men, and .007 ± .103 for women. Both correlations were statistically insignificant. On the other hand, the correlation coefficients between form and color were

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[2] Chi-square = 1.23, not significant; Coefficient of contingency = .117 ± .106.

[3] Chi-square = 6.68, significant at .01 level; Coefficient of contingency = .266 ± .106.

[4] Chi-square = 125.47, significant at .01 level; Coefficient of contingency = .766 ± .106.

—.296 ± .065 (significant at .01 level) for men, and — .205 ± .099 (significant at .05 level) for women. These findings are not in line with the validity of Rorschach's crucial indicators (M:Sum C) of personality types.

E. SUMMARY

In order to establish the validity of the group Rorschach with regard to the assessment of introversion-extraversion, the ratios of Rorschach human movement to color responses were compared with two external criteria: an introversion-extraversion questionnaire and assessments made by judges. The results, obtained from the testing of 286 adults, show that the group Rorschach, when using the traditional determinant categories, fails to measure introversion-extraversion as measured by the questionnaire and the judges' assessments. It also appeared that the ratio between the form and the color give better results than the human movement to color proportion.

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VITAMIN DEFICIENCIES IN MENTAL ILLNESS*

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A. THE PROBLEM

Both psychoneuroses and psychoses apparently can be induced experimentally by dietary restrictions (3, 4). The resultant abnormal mental and emotional states are not clinically distinguishable from psychologically diagnosed functional mental illness (2, 3). Because of this fact, some emotional illness which is presently thought to have no organic basis may be the result of certain types of subclinical nutritional deficiencies (7).

An exploratory test of this hypothesis was made by Watson and Comrey (8). They administered specially balanced formulas of large quantities of all the vitamins and minerals known or believed important in human nutrition to a test group of emotionally disturbed subjects. Improvement was statistically significant both with respect to clinical symptoms and to scores on the Minnesota Multiphasic Personality Inventory.

The experiment to be reported represents an attempt to obtain additional information concerning the relationship between possible subclinical vitamin and mineral deficiencies and emotional illness.

B. PROCEDURE

Twenty-three unhospitalized ambulatory subjects were selected for the experiment both on the basis of their Minnesota Multiphasic Personality Inventories, and on the basis of the length of time their psychological histories indicated that they had been emotionally disturbed. All had one or more abnormal test scores. The range of the lengths of time that they reported being emotionally disturbed was from three to 15 years.

All 23 subjects were first assigned to the placebo group. The design of having each subject act as his own control was selected because of the difficulty of matching subjects into control and experimental groups, and because it is important to know whether or not there are "placebo reactors"

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[1] With the assistance of David L. Rabinowitz, M.D., who conducted the physical examinations and supervised the laboratory tests.

(1, 5) in the experimental group, and this obviously cannot be determined unless each experimental subject first receives placebos.

The range of times that subjects remained in the placebo group was from one to two and one-half months. Subjects were transferred from the placebo to the experimental group when they reported they were "not improving," in addition to having no significant changes in Minnesota Multiphasic Personality Inventory profile.

The average length of the experimental period was 2.9 months; the range was from one to six months. Two subjects received treatment for one month; five for two months; seven for three months; three for four months; one for five months; and one for six months.

These variations in the lengths of treatment were due to differences in degrees of emotional disturbance; apparent differences in the rates of response; and time-consuming procedures in adjusting the basic formula in certain cases, as indicated below.

Clinical evaluations were based upon the following criteria: alterations in attitudes toward problems (e.g., "I no longer resent my mother-in-law"); changes in real life situations (e.g., capacity for work; getting a job for the first time in several years); renewal of hope (e.g., orientation to the future, "I think I'll resume my education and get a higher degree"); improvement in emotional stability (e.g., "I really feel good for the first time in years. Nothing has really changed, but things that used to bother me I never think about any more"); as well as appraisal of self and attention to physical appearance.

Minnesota Multiphasic Personality Inventory profiles were interpreted in terms of a "total score" (8), which was computed by summing the following scores: Hs plus .5K, D, Hy, Pd plus .4K, Pa, Pt plus 1K, Sc plus 1K, and Ma plus .2K.

Brief psychological case histories were taken in the initial interview, as well as nutritional data on diet and approximate caloric intake. Medical histories were also obtained, and complete physical examinations and laboratory tests were given to all subjects. Monthly, bi-monthly, and sometimes weekly medical checks were made as necessary. Clinical psychological data were obtained by interview at approximately one-month intervals, and in some cases oftener, at which times Minnesota Multiphasic Personality Inventory retests were obtained.

The basic formula for the experimental group is given in Table 1. This represents an attempted improvement over that used in (8), based upon the findings in that study. These materials were administered orally daily, in the form of nine capsule-shaped tablets, three to be taken with each meal. At each interview, subjects were given sufficient tablets for one month's intake.

Some subjects received clinical adjustments in the basic formula. In certain instances the formula employed in (8), while apparently not greatly

TABLE 1
NUTRITIONAL REPLACEMENT FORMULA*

Vitamin A	40,000	USP Units
Vitamin D	5,000	USP Units
Vitamin C	300	mg.
Vitamin K	0.2	mg.
Vitamin E	50	I.U.
Vitamin B-1	25	mg.
Vitamin B-2	25	mg.
Vitamin B-6	25	mg.
Vitamin B-12	10	mcg.
Niacinamide	150	mg.
Niacin	25	mg.
Folic Acid	1.5	mg.
Calcium Pantothenate	25	mg.
Para-aminobenzoic Acid	100	mg.
Biotin	25	mcg.
Inositol	50	mg.
Choline	47.9	mg.
Betaine Hydrochloride	100	mg.
Pectin	32	mg.
Calcium	1,000	mg.
Phosphorous	750	mg.
Iron	20	mg.
Iodine	0.6	mg.
Copper	0.35	mg.
Fluorine	0.5	mg.
Manganese	10	mg.
Cobalt	0.5	mg.
Nickel	0.2	mg.
Molybdenum	0.2	mg.
Magnesium	10	mg.
Potassium	0.6	mg.
Sulfur	1.0	mg.
Zinc	0.2	mg.

*Nutritional Replacement Formula K-54 (R) supplied by the Kalash Vitamin Corporation, Pasadena, California.

In addition to the above vitamins and minerals, K-54 contains: *Enzymes*: mycozyme 100 mg., papain 100 mg.; *Bioflavonoids*: lemon peel infusion 25 mg., hesperidin 10 mgs., rutin 25 mgs.; *Amino Acids*: glutamic acid 50 mgs., dl methionine 100 mgs., glutamine 100 mgs.; *Natural Concentrates*: (as a possible source of unisolated biocatalysts): green plant factors (escarole, alfalfa, parsley, watercress) 196 mgs., lecithin 25 mg., chlorophyll 10 mg., red bone marrow 35 mg., primary yeast 100 mg., sea salt (as a source of trace elements) 100 mgs., sea lettuce 600 mgs., wheat germ 100 mg., desiccated liver 64 mgs.; *Fatty Acids*: mixed unsaturated 20 mg.

different biochemically from that employed in the present study, appeared to be more satisfactory from a clinical point of view. Further, some subjects appeared to respond better to the basic formula when more B_{12}, C, Calcium, and Phosphorous, for example, were added in combination with slightly less B_1, B_2, and B_6. Finally, two subjects were found to respond best when vitamins B_1, B_2, B_6, PABA, and D were not included in the formula. These types of adjustments were determined after a long period of clinical testing, antedating both the present experiment and that reported in (8).[2]

C. RESULTS

The Minnesota Multiphasic Personality Inventory total scores for the beginning and ending of both the placebo and experimental periods are given in Tables 2 and 3.

Of the 23 subjects who began the experiment, 19 completed it. None of the four subjects who dropped from the research took the first experimental Minnesota Multiphasic Personality Inventory test.

Of the 19 placebo subjects, five improved, four got worse, and 10 showed no change, judged on a clinical basis. Applying a sign test to these data, the clinical improvements for the placebo group are not statistically significant. Judged in terms of improvement in the Minnesota Multiphasic Personality Inventory profile, the average placebo reduction in total test score was 5.1 points. This average total test score difference for the placebo trial is not statistically significant.

Of 19 experimental subjects, 16 improved, one got worse, and two showed no change, judged in terms of clinical criteria. Applying a sign test to these data, the clinical improvements for the experimental group are significant at the .01 level of confidence. In terms of Minnesota Multiphasic Personality Inventory profile, the average reduction in total test score for the experimental group was 19.2 points. This difference for the experimental period is significant at the .05 level of confidence.

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[2] Subjects 5, 8, and 11 received the formula employed in (8), which differs slightly from the one used in this experiment, principally in having 10,000 fewer units of vitamin A, 15 mgs. less of B_6, as well as other minor differences. Subjects 14, 15, and 19 received a variation of the basic formula, containing, for example, more vitamin C (500 mgs.), B_{12} (15 mcgs. and one oral unit), calcium (3 gms.), phosphorous (1.6 gms.); and less B_1 (10 mgs.), B_2 (10 mgs.), and B_6 (5 mgs.). Subjects 9 and 16 received a special formula differing fundamentally from that listed in Table 1 or from the above adjustments in it. This formula contained: vitamin E, 300 I.U., C, 600 mgs., niacinamide, 600 mgs., B_{12}, 5 USP units, folic acid, 5 mgs., ferrous sulfate, 400 mgs., cobalt chloride, 20 mgs., calcium lactate, 500 mgs., hesperidin, 500 mgs.

TABLE 2

MINNESOTA MULTIPHASIC PERSONALITY INVENTORY RESPONSE TO PLACEBO TRIAL*

Subject	Age	Sex	F	K	Hs+.5K	D	Hy	Pd+.4K	Pa	Pt+1K	Sc+1K	Ma+.2K	Total Score
1	19	M	6	9	7	26	24	26	11	35	31	19	179
			6	12	8	29	24	29	10	37	34	18	189
2	63	F	1	16	23	29	27	19	4	28	27	12	169
			2	19	18	25	26	24	7	30	25	11	166
3	47	M	16	10	31	32	37	36	18	39	51	26	270
			17	8	27	35	33	38	16	42	51	27	269
4	37	M	4	10	11	27	21	18	8	34	28	9	156
			6	9	12	27	20	22	7	34	30	12	164
5	43	F	6	16	16	37	27	20	6	30	34	12	182
			3	20	17	34	24	22	8	32	33	12	182
6	42	F	6	20	22	37	34	33	14	36	36	17	229
			7	22	21	32	32	37	14	32	35	20	223
7	43	F	5	11	26	32	35	23	12	32	30	20	210
			4	12	25	29	33	26	14	33	29	22	211
8	53	F	14	9	21	19	22	27	14	29	34	28	194
			8	14	16	19	20	27	11	25	32	29	179
9	34	F	8	11	29	39	33	20	13	38	30	11	213
			8	12	23	37	32	20	10	38	30	12	202
10	35	M	5	14	22	31	28	30	15	36	29	17	208
			10	15	20	31	31	28	11	36	29	14	200
11	46	M	6	18	19	44	35	26	13	46	34	14	231
			11	16	20	29	28	30	13	47	40	10	217
12	37	F	10	12	30	42	44	29	15	48	44	19	271
			9	16	35	38	40	23	11	45	46	12	250
13	47	M	0	15	25	24	27	17	12	20	24	15	164
			3	17	24	20	25	14	11	19	23	12	148
14	26	M	6	7	9	26	22	21	8	28	28	25	167
			8	4	9	23	18	21	6	25	27	26	155
15	34	M	13	8	29	36	31	31	14	43	42	21	247
			11	8	25	35	26	30	12	43	44	23	238
16	41	F	13	10	14	30	33	33	14	41	44	20	229
			15	15	21	40	39	35	15	52	51	20	273
17	28	M	7	11	21	30	24	24	12	39	34	22	206
			5	13	14	28	25	25	14	33	27	23	189
18	38	F	8	15	19	31	28	38	12	27	32	20	207
			10	19	16	27	24	33	11	30	32	18	191
19	44	F	14	19	33	41	45	39	14	58	62	24	316
			16	14	30	39	45	42	13	51	58	28	306

*The first listed total score for each subject is for his initial test; the second is for his score at the end of his placebo period.

TABLE 3
MINNESOTA MULTIPHASIC PERSONALITY INVENTORY RESPONSE TO EXPERIMENTAL NUTRITIONAL REPLACEMENT THERAPY*

Subject	Age	Sex	F	K	Hs+.5K	D	Hy	Pd+.4K	Pa	Pt+.4K	Sc+1K	Ma+.2K	Total Score
1	19	M	6	12	8	29	24	29	10	37	34	18	189
			7	8	6	22	20	20	8	20	16	12	124
2	63	F	2	19	18	25	26	24	7	30	25	11	166
			1	20	20	25	23	19	5	27	25	9	153
3	47	M	17	8	27	35	33	38	16	42	51	27	269
			21	8	28	28	34	35	15	36	48	33	257
4	37	M	6	9	12	27	20	22	7	34	30	12	164
			5	10	10	28	19	20	6	34	30	9	156
5	43	F	3	20	17	34	24	22	8	32	33	12	182
			3	20	13	29	23	22	7	30	31	12	167
6	42	F	7	22	21	32	32	37	14	32	35	20	223
			4	19	18	33	29	33	15	33	35	19	215
7	43	F	4	12	25	29	33	26	14	33	29	22	211
			6	14	21	27	31	28	12	33	27	22	201
8	53	F	8	14	16	19	20	27	11	25	32	29	179
			8	15	12	16	15	27	10	27	29	26	162
9	34	F	8	12	23	37	32	20	10	38	30	12	202
			6	16	20	33	25	19	8	29	30	11	175
10	35	M	10	15	20	31	31	28	11	36	29	14	200
			5	24	21	28	30	28	12	39	29	18	205
11	46	M	11	16	20	29	28	30	13	47	40	10	217
			12	19	19	42	36	33	16	49	39	15	249
12	37	F	9	16	35	38	40	23	11	45	46	12	250
			8	16	30	37	41	28	13	41	43	17	250
13	47	M	3	17	24	20	25	14	11	19	23	12	148
			2	22	20	22	27	21	11	24	26	17	168
14	26	M	8	4	9	23	18	21	6	25	27	26	155
			5	5	7	19	17	19	7	21	24	23	137
15	34	M	11	8	25	35	26	30	12	43	44	23	238
			10	7	20	31	23	27	10	36	41	22	210
16	41	F	15	15	21	40	39	35	15	52	51	20	273
			13	16	14	33	30	34	16	48	48	25	248
17	28	M	5	13	14	28	25	25	14	33	27	23	189
			5	19	15	20	19	23	11	31	27	18	164
18	38	F	10	19	16	27	24	33	11	30	32	18	191
			8	22	13	19	22	30	10	29	34	11	168
19	44	F	16	40	30	39	45	42	13	51	58	28	306
			7	20	14	19	25	33	9	28	31	19	178

*The first listed total score for each subject is for his initial test at the start of the experimental period; the second is for his score at the end of the experiment.

D. Discussion

The following is a summary of individual case histories. These are included to indicate types and degrees of clinical improvements as related to changes in Minnesota Multiphasic Personality Inventory test scores.

1. *Subject 1, Male, Age 19*

Medical finding: facial dermatitis, believed to be partly psychogenic. He reported being withdrawn and very depressed, afraid to meet anyone. His mother reported that he would not eat meals with the family, and that he had not talked with his father for "two or three years." He would stay in his room, and would not enter rooms where other members of the family were. He confided to some degree in his mother, however. In the initial interview he would hardly speak. After one month on placebos he reported being slightly worse; his Minnesota Multiphasic Personality Inventory total score had increased 10 points. At the end of one month of experimental treatment, he was considerably more at ease and talked rather easily. He continued to improve steadily, and at the end of the fourth experimental month, his mother reported:

> He is coming out of it. He cut the lawn voluntarily for the first time in years; he has come out of his room and watched television in the livingroom with the family. He also has had several long, confidential talks with his father for the first time in several years. His recovery, frankly, is more than we had hoped for.

At the end of the experimental period, he had improved markedly. His Minnesota Multiphasic Personality Inventory profile had returned to normal, a reduction in total score of 65 points.

2. *Subject 2, Female, Age 63*

Medical findings: arthritis, hypertrophic; non-toxic thyroid nodule. She reported being a "highly nervous and upset person." Her Minnesota Multiphasic Personality Inventory showed elevated scores on hypochondriasis and depression. She complained that her husband "had always put his mother first," and that she had lived with her mother-in-law for 43 years. She showed no improvement on placebos. After three months' experimental treatment she stated:

> I just feel so well you'd better scratch me off your books. I'm not nervous; my mother-in-law doesn't bother me so much. You can just say I feel *less resentful* about everything. I can see that one can be happier.

Her Minnesota Multiphasic Personality Inventory returned to normal.

3. *Subject 3, Male, Age 47*

Medical finding: no contributory organic disease. He reported being very depressed and exhausted most of the time. He scored high on the schizophrenia scale. His total Minnesota Multiphasic Personality Inventory score decreased one point during the placebo trial of one month; but at the end of the first month of experimental treatment it had decreased 20 points, and clinically he appeared much calmer and did not dwell on the hopelessness of his situation. He stated, however, that he did not think he was improving. This subject was in an interpersonal situation that he considered to be intolerable and inescapable. He was unhappily married, and in a job which he said he "detested" but had to retain. He interrupted his treatment with a lengthy vacation and left the experiment soon after returning, convinced that it would not help his problems.

4. *Subject 4, Male, Age 37*

Medical finding: no contributory organic disease. He reported "loss of confidence," and recurrent periods of very deep depression. During the placebo trial he became disappointed that the tablets weren't helping him, and his total Minnesota Multiphasic Personality Inventory score got slightly higher. At the start of the second week of experimental treatment, he began to have indigestion and constipation. He was given an enzymatic digestive aid, to help him assimilate the nutritional replacement formula.[3] Gradually his recurrent periods of deep depression became fewer and fewer until he reported that they had ended. Even though he stated that he had improved considerably psychologically, he also stated that he still did not have the energy and confidence of his former years, although he had meanwhile undertaken a new and more difficult job. This case represents another instance of an apparently substantial psychological improvement with no alteration in Minnesota Multiphasic Personality Inventory Profile.

5. *Subject 5, Female, Age 43*

Medical finding: no contributory organic disease. She reported being psychologically depressed and generally inadequate. She stated: "my emotions are all very dead." Her Minnesota Multiphasic Personality Inventory showed an elevated score on depression. She improved clinically the first month on placebos; but her Minnesota Multiphasic test showed no change. After two months on placebos, she reported a regression, and was switched to experimentals. After one month's treatment she reported that her energy was up and that she hadn't experienced any "nervous spells." At the end of the experiment her total test score was within normal range, and she reported feeling normal psychologically.

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[3] Zymagest (R) (Kalash) containing: ox bile extract 125 mg. mycozyme, 125 mg., betain HCL 100 mg., papain 100 mg., and pancreatin, 125 mg., : two or three with each experimental dosage (after meals).

6. *Subject 6, Female, Age 42*

Medical finding: peripheral neuropathy (history); trophic ulcers, both feet. In the initial interview she reported feeling depressed, frustrated, and generally inadequate; she had been unable to seek employment or do anything for several years. She appeared to be mentally confused; spoke with a very slow, childlike voice-pattern. No change was noted at the end of the first month of the placebo trial. At the end of the first month of the experimental treatment, she reported that she had re-enrolled in school. Her voice pattern had returned to normal, and she appeared considerably more alert mentally. At the end of the third month of treatment she reported obtaining a job. She appeared calm and relaxed for the first time since the beginning of the experiment. Although her total score on the Minnesota Multiphasic Personality Inventory decreased only eight points over the end of the placebo period, she had recorded marked improvement in overall psychological adjustment.

7. *Subject 7, Female, Age 43*

Medical finding: no contributory organic disease. She reported being depressed, subject to crying spells, and physically inadequate to maintain her house. She stated that she "ached all over." She showed no improvement on placebos either clinically or on the Minnesota test. She improved slightly on the experimental treatment; the "aching all over" stopped and her test score dropped 10 points. This subject was an arrested tubercular, who said that she had had tinnitus for four years, ever since she had received antibiotic therapy for pneumonia. In addition, she had a very severe sinus condition. At the end of the experiment she felt that she needed to continue the nutritional support, even though her psychological improvement was judged insignificant.

8. *Subject 8, Female, Age 53*

Medical finding: no contributory organic disease. She reported extreme fatigue, flights of anger, and excessive hostility. Her family stated that she had delusions, and had made several attempts to run away. She scored high on the hypomania scale. In the initial interview she was hostile and excitable, with a very rapid voice pattern. She reported "being hungry all of the time," and eating constantly. She made an initial and short-lived gain clinically on placebos and her total test score dropped 15 points. After one month of experimental treatment she lost her manic voice pattern, impatience of manner, and general irritability. Previous treatment by her family doctor with reserpine over a period of six months had apparently not affected these symptoms. After two months on nutritional replacements her family reported that she had lost almost all of her aggressiveness. Her appetite returned to normal. At the end of four months' treatment she appeared clinically normal, and she obtained a selling job in a department store. Her Minnesota score had changed from 179 to 162.

9. *Subject 9, Female, Age 34*

Medical finding: no contributory organic disease. She reported feeling anxious and tense most of the time, angering easily, and subject to extreme exhaustion. She stated that she had had a "constant" headache for several years, for which no physical cause could be found. She also stated that she "could eat all of the time." She scored high on the depression, hypochondriasis, and hysteria scales. She reported being worse on placebos, stating they were "sugar pills." At the end of the first month on experimentals, she stated that she "does not long for bedtime now," and that she was less depressed. She reported that the experimental treatment gave her more energy. Her Minnesota Multiphasic Personality Inventory total test score showed a reduction of 27 points at the end of the experimental period.

10. *Subject 10, Male, Age 35*

Medical finding; diabetes mellitus, mild, not believed to be contributing to emotional symptoms. He reported numerous somatic complaints, such as sharp chest and arm pains, for which no organic cause could be found. He was quite depressed, and stated that his depression had been increasing in severity for about five years. In the initial interview he said that he didn't know whether he could "keep going to the next moment" or not. He showed no improvement on placebos. At the end of the experimental period he said: "I have shown remarkable improvement. When I started the experiment I was about at the end of my rope. Now I'm a different person entirely." He also stated: "My likes and dislikes have changed. I like different music; I wear different clothes; my business associates say 'you are a different person.'" Independently his wife reported: "he seems like a different person." Despite marked clinical improvement, this subject's MMPI total score increased five points during the experimental period.[4]

11. *Subject 11, Male, Age 46*

Medical finding: hypertension, not believed to be contributing to psychological symptoms. He reported being highly anxious, depressed, and exhausted most of the time; unable to work. He scored extremely high on the depression scale, also high on the psychasthenia scale. He reported feeling "perhaps" slightly better on placebos, but worse on one month's experimental treatment, after which he left the experiment. His Minnesota test score had increased 32 points.

12. *Subject 12, Female, Age 37*

Medical finding: no contributory organic disease. She reported extreme tension, anxiety, exhaustion, and depression. She stated that she felt as though she was "cracking up" and on the way to a mental hospital. Her Minnesota test showed elevated scores on six out of eight scales. She reported that she felt much worse on placebos, and also said she believed that she had been given placebos. She reported having more energy on the experimental treatment. She also said that she was not so depressed, but was still very tense and anxious. At the end of the experimental period there was no change in her total test score, and she was essentially unchanged clinically.

13. *Subject 13, Male, Age 47*

Medical finding: duodenal ulcer, asymptomatic. He reported being "on the verge of tears" psychologically most of the time, also quite hostile and suspicious. He felt his business associates were "picking on" him. He improved slightly on two months' placebos, after which time he felt that he had regressed. At the end of the experimental period he reported: "I no longer feel inadequate on my job, and I don't have a 'chip' on my shoulder all the time." Although this subject stated: "I now feel like myself again," at the end of the experiment, his Minnesota Multiphasic Personality Inventory total score had increased four points over his initial test.

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[4] An increase in total Minnesota Multiphasic Personality Inventory score purports to indicate a greater degree of emotional illness; a decrease, a lesser degree (8).

14. *Subject 14, Male, Age 26*

Medical finding: psychomotor epilepsy. This subject was simultaneously under study at the Neurology Clinic, U.C.L.A. Medical Center. His physician stated that he had a "personality difficulty which has complicated the regulation of his seizures." He was receiving anti-convulsant medication in the form of a combination of Mysoline and Dilantin. He reported being "easily frustrated to anger." For example, he attempted to smash the television tube when his father told him to change the program. Clinically he appeared to be hostile and slightly depressed, but not anxious. His Minnesota test showed borderline abnormalities on the depression and mania scales. On the first month of placebos, he stated that he wasn't so easily frustrated, and his father reported that his son had generally improved. At the end of the second month of placebos, both the subject and his father reported that they felt no further improvement had been made. At the end of two months' experimental treatment his father stated that his son's condition "is vastly better than it ever has been." Clinically the subject seemed more at ease and more alert. He was now concerned with finding a job and doing something constructive, where before he had not appeared interested in anything. Since the subject was also receiving other medication in addition to nutritional replacements, it was decided to discontinue the vitamins and minerals to determine if they were playing any substantial rôle in his improvement. After about three weeks without nutritional support, his mother called and said that her son had regressed; that "he was now irritable; that his attacks had increased, and that he was now inactive, sleeping most of the time." She also stated that "he was a totally different boy than he was last month. There has been increasing tiredness, loss of interest and loss of desire to go out, forgetfulness and confusion, and less co-operation, with some increase in irritability and arguments." Upon resuming the experimental period he improved psychologically to the point of obtaining a job without aid. The job turned out to be too difficult and he gave it up. At the end of the experimental period he had shown rather great psychological improvement, and his Minnesota total test score was now normal.

15. *Subject 15, Male, Age 34*

Medical finding: no contributory organic disease. He reported being excitable to the point of not being able to hold a job; he hadn't worked in over two years. He stated that he "was angered easily to tears." Clinically he appeared to be hypersensitive and withdrawn. He had abnormal scores on six out of eight scales on the Minnesota Multiphasic Personality Inventory. After one month on placebos he said that he thought he was less nervous, and more interested in finding a job (although he didn't look for one). After the second month on placebos he said that the effect of the treatment was "just imagination, maybe." At the end of the first month after being switched to experimentals he got a job for the first time in two and one-half years. He stated that his "anger" was far less noticeable, and that he was generally more calm; he also said, "I used not to care much about things in general, now I do." At the end of the experiment he stated that he definitely felt better, and that he could control himself now. His Minnesota Multiphasic Personality Inventory total score had improved by 28 points.

16. *Subject 16, Female, Age 41*

Medical finding: Multinodular goiter, non-toxic. In the initial interview she reported feeling generally inadequate, irritable, depressed, and easily frustrated. She appeared quite hostile, clinically. Her Minnesota test showed relatively high scores on the psychopathological deviate and schizophrenia scales. At the end of one month on placebos, she said she thought the tablets had increased her appetite, and that she felt better. After 10 weeks on placebos she stated that she had had a "junior breakdown"; she reported feeling "frightfully tired" and "strange emotionally." At the end of one month's experimental treatment she reported that she was feeling "wonderful." Her total score on the Minnesota test had dropped 25 points over the end of the placebo period.

17. *Subject 17, Male, Age 28*

Medical finding: no contributory organic disease. In the initial interview he reported feeling "sad" most of the time, easily frustrated, irritable, excitable, and "tired" more often than not. His Minnesota Multiphasic Personality Inventory showed elevated scores on the hypochondriasis, depression, psychasthenia, and schizophrenia scales. At the end of the first month's placebo trial he stated that the tablets made him slightly "more tolerant" to situational difficulties. After two months on placebos he said that he was no better. At the end of one month on experimentals he stated that he had been "feeling wonderful." He reported that he no longer felt tired every morning upon awakening, and his depression had left. His Minnesota Multiphasic Personality Inventory had returned to normal.

18. *Subject 18, Female, Age 38*

Medical finding: no contributory organic disease. She reported being quite depressed, easily angered, inadequate, irritable, and excitable. Her Minnesota test showed a slightly elevated score on psychopathological deviation, and a slightly elevated score on depression. On the first month of the placebo trial she reported that she thought the tablets had increased her appetite, but that she had "a very stormy month." She seemed more tense and more excitable. At the end of the first month of the experimental period she stated that she definitely felt better. She reported being more relaxed, more calm, and she said her energy appeared to be up. She stated that her superior at work had mentioned an improvement in her performance. At the end of the experimental period she said "I feel friendlier; I like people now. I'm not depressed." She also remarked that her friends had noticed that she was more friendly. Her total score on the Minnesota Multiphasic Personality Inventory had decreased 23 points, and she had made a rather marked gain clinically.

19. *Subject 19, Female, Age 44*

Medical finding: no contributory organic disease. She was a former alcoholic, helped by Alcoholics Anonymous. She scored extremely high on both the psychopathological deviation and the schizophrenia scales, and reported feeling on the verge of "complete collapse." When asked in the initial interview if she cried easily, she broke down and sobbed. She stated that she was hysterical, hostile, and excitable. After one month on placebos, she reported "they may have helped me. I didn't expect any amazing results, and I didn't get any." After being switched to experimentals without her knowledge she stated:

> I experienced a tremendous improvement this past month. Previously I had a perpetual lump in my throat, but this month I felt it only a couple of times. I have also felt happier, and my outlook is somewhat different. Frankly I've never amounted to anything in my life, but now I'd like to go on and learn something.

At the end of four months' treatment, when asked why she hadn't completed her final Minnesota Multiphasic Personality Inventory test, she said: "I know this sounds funny, but I have felt so wonderful that I didn't want to lose time by sitting down to answer the test." Her total Minnesota Multiphasic Personality Inventory score decreased 128 points, and she appeared to be recovered clinically.

E. Conclusion

Multiple vitamin and mineral deficiencies are apparently etiological factors of fundamental importance in some kinds of emotional disturbances. In previous research (6, 7, 8), as well as in the experiment here reported, the following types of disorders have been studied: schizophrenia, depression, hysteria, hypomania, psychasthenia, psychopathological deviation, paranoia, and hypochondriasis. Cases of each of these types of emotional disorders, as diagnosed and retested on the Minnesota Multiphasic Personality Inventory, apparently have been brought from abnormal to normal by means of nutritional replacement therapy, without the aid of psychotherapy.

The results of this experiment tend to confirm the hypothesis that multiple vitamin and mineral deficiencies are involved in the origin of some mental illness that hitherto has been considered to be entirely psychogenic.

F. Summary

Experimental neuroses as well as experimental psychoses apparently can be induced in normal subjects by restricting their nutritional intakes (3, 4). Neuroses and psychoses which are caused by nutritional deficiencies cannot be distinguished clinically from psychiatrically diagnosed functional mental illness (2, 3). Since this is true, some mental illness which is currently believed to be entirely psychogenic in origin may in part originate from unsuspected, sub-clinical nutritional deficits.

The experiment reported here is the second study on the effect of nutritional replacement therapy for mental illness. In a previous test (8), 32 subjects were administered large quantities in specially balanced formulas of all the minerals and vitamins known or believed to be important in human nutrition. The Minnesota Multiphasic Personality Inventory was employed for original diagnosis, as well as for retesting as an objective measure of improvement. Profiles on the Minnesota test were interpreted in terms of a "total score," which was computed by summing the scores from eight scales (hypochondriasis, depression, hysteria, psychopathic deviate, paranoia, psychasthenia, schizophrenia, and hypomania). In addition to guaging improvement in terms of the reduction in total test scores on the Minnesota Inventory, clinical evaluations were also made in terms of the following criteria: changes in emotional stability, mental confusion, orientation to the future, appraisal of self, attention to physical appearance, and capacity for work. Expressed in terms of a "total score" (8) on the Minnesota test, the placebo group showed a median improvement of one score point, while

the experimental group showed a median score improvement of 22 points. This difference in favor of the experimental group is significant at the .03 level of confidence. Improvements as judged in terms of the clinical criteria stated above, and determined independently of the Minnesota Multiphasic Personality Inventory, favored the experimental group over the placebo group at the .01 level of confidence.

In the second experiment on nutritional replacement for mental illness reported in this article, 23 subjects were selected on the basis of their abnormal Minnesota Multiphasic Personality Inventory profiles, as well as on the basis of the lengths of time they reported being disturbed mentally. Each subject represented what appeared to be a long standing case of emotional illness.

All subjects were first assigned to the placebo group, to determine whether or not any were "placebo reactors." Subjects were transferred without their knowledge from placebos to experimentals when they showed no significant improvement either clinically or on the Minnesota test with the placebo treatment.

Of the 23 subjects who began the experiment, 19 completed it. On the placebo treatment, four subjects got worse, five improved, and 10 showed no change, judged in terms of clinical criteria. Applying a sign test to these data, the clinical improvements for the placebo group are not statistically significant. Judging the placebo reaction in terms of change in total test score for the Minnesota Multiphasic Personality Inventory, the average reduction in score for the placebo group was 5.1 points. This difference for the placebo trial is not statistically significant.

Of the 19 subjects in the experimental group, 16 improved significantly, one got worse, and two showed no change, judged by clinical criteria. In terms of a sign test, the clinical improvements for the experimental group are significant at the .01 level of confidence. Evaluating improvements by reduction in total test score on the Minnesota Multiphasic Personality Inventory, the average improvement in score for the experimental group was 19.2 points. This difference is significant at the .05 level of confidence.

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EMOTIONAL ASSOCIATIONS WITH AIR AND RAIL TRANSPORTATION*[1]

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A. INTRODUCTION

Within a brief 50 years, air transportation has become a major cultural influence on Western Civilization. Without the benefit of historical preparation, the individual has been forced to integrate this new and insistent element into both his thinking and his social life. Suddenly, almost full-blown, the air age exists.

When an item as new and as intense as air travel strikes a cultural front, it is to be expected that people will have some equally new and intense feelings about it. Many of these feelings will not be rational or intellectual, but their impact on social behavior will be no less impressive as a result. In many respects the ability of modern man to emotionally integrate the airplane is no greater than the ability of the primitive to integrate his first experiences with the white man in armor, astride his stallion.

Although cause of considerable comment and rational speculation, there is still little empirical evidence of the sociological and psychological impact of this new transportation media. Perhaps this semi-void can be attributed to the newness of the problem, perhaps to the relative lack of research in the areas of transportation, perhaps to the complexity of the problem in general. Nevertheless, the literature on the socio-psychological aspects of air transportation is relatively light. Existing reports largely depend upon case study methods and concentrate upon the more clinical problems, especially as they relate to military aviation.

Air transportation apparently produces some intense emotional experiences for individuals, differing perhaps only in kind and extent from the emotional experiences associated with any new and impressive cultural phenomenon. Cultural items must always be integrated into the emotional lives of the people who are in contact with them. Each individual must

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[1] This paper is one of a series of empirical studies of major social phenomena as seen from the psychodynamics viewpoint.

form his own complex configuration of impressions. In one way or another, he must decide exactly what the structure, function, and meaning of each experience is to be for him personally. Through a process which includes conceptualization, evaluation, conclusion, and decision, his real world is translated into a "world inside his head."

The present study is concerned with assessing some of these feelings which people have when confronted by air travel and, in comparison, by the now more traditional rail travel experience.

There are usually common elements among the patterns of associations held by differing individuals. This common core we might label the pattern of stereotyped associations. And as such, we are concerned with obtaining an empirical picture of the stereotyped associations with both air and rail travel. As in similar investigations, one of the first problems of research involves the question of absolute versus relative measurement. In our case, in order to assess the emotional stereotypes concerning air transportation at a relative level of measurement, rail transportation was used to establish a relative base line. In this way it was possible to outline the magnitude and direction of the differences in stereotyped feelings between these two media. In order to obtain absolute measures, a standardized method of assessment (1) was used.

To gain some general impression of emotional experience, one must resort to some form of personal questioning. But, as the emotional content becomes more intimate and answers more revealing, defenses are thrown up. As a result, an attempt was made to use techniques designed to breach these defenses in order to tap significant material. In this study, two such techniques were applied. First, the Polydiagnostic method of questioning used was originally developed for use in the clinic. It was designed to reduce the subject's ability to distort his responses when dealing with emotionally loaded material. Second, the subjects were questioned not about their own feelings but about the feelings of "people in general." In this respect, this was a projective form of questioning.

B. The Research Design

Since the Polydiagnostic method of social research is still relatively unpublicized, a brief outline of the research procedure is presented here. In Polydiagnostic research, the subject's vocabulary is always restricted to the use of a set of 15 descriptive adjectives. There are 20 such sets, each of known reliability and standardized. The last five of these sets (Sets 16-20) were selected for this research (see Table 1).

TABLE 1
POLYDIAGNOSTIC ASSOCIATION SETS

List 16	List 17	List 18	List 19	List 20
Brave	Calm	Careful	Angry	Anxious
Cheerful	Clean	Curious	Ashamed	Bitter
Decent	Exact	Faithful	Cheap	Cruel
Firm	Frank	Friendly	Evil	False
Gallant	Generous	Gentle	Fearful	Fierce
Graceful	Grateful	Honest	Foolish	Guilty
Intelligent	Kind	Loyal	Hasty	Helpless
Modest	Moral	Neat	Jealous	Lazy
Original	Patient	Peaceful	Loud	Lying
Powerful	Practical	Prompt	Nervous	Reckless
Proper	Quick	Reasonable	Rough	Rude
Religious	Responsible	Serious	Savage	Shallow
Sincere	Smart	Social	Silly	Slow
Spiritual	Strong	Tender	Vain	Weary
Understanding	Willing	Wise	Wicked	Wild

The standard procedure for Polydiagnostic questioning was used with only the minimum modifications required by the research design. The subject was presented with the first of the sets of terms. He was given the following instructions. "How do you think people in general feel when they travel by airplane? From this set of words choose the three which you think most describe the way people in general feel when they travel by airplane." The subject made his choice and these three terms were crossed out of the set, leaving 12 terms remaining. The administration continued, "Again choose the three words which you think now most describe the way people in general feel when they travel by airplane." Again three words were selected and crossed out. The administration continued, "Again choose the three words" etc. Three more words were removed. Again the subject was instructed to select three words from the remaining six. This left three residual words. In this manner the subject progressed through the five lists of 15 association terms each.

Each of the 15 items within a set is assigned a score on the basis of when it was chosen. Each characteristic is scored +4 if it is chosen within the first choices, +3 if it is chosen second, +2 if it is chosen third, +1 if it is chosen fourth, 0 if it is one of the three words left over.

The identical procedure was duplicated for each subject in respect to rail transportation. Under these conditions the questioning was the same except that the word "train" was substituted for the word "airplane." Both lists and instructions were counter-balanced in order of presentation. The words within each list, however, were left in their standardized arrangement.

The 47 subjects were pre-selected as having met one major criterion; they had traveled at least 200 miles by either airplane or train within the previous year.

C. Results

In this manner we obtained two scores for each of the 75 characteristics; one as associated with the airplane, the second as associated with the train. For each of the 75 characteristics two mean scores were calculated. Theoretically a mean of 4.00 is the highest possible; it would reflect an absolutely perfect agreement of maximum closeness of association of the term with the transportation media. A mean of 0.00 would reflect equally perfect agreement that the association was low.

A mean of greater than 2.47 or less than 1.53 would be significantly different from that to be expected on the basis of chance at the 1 per cent level of confidence. Using this 1 per cent level of confidence to establish cutting lines, we can divide the 75 association scores into three groups; those of significantly high intensity, those not significantly different from chance expectancy, and those of significantly low intensity. Such a breakdown is presented for the airplane in Table 2 and for the train in Table 3.

Tables 2 and 3 are based upon the assignment of cardinal numbers to the various score positions to obtain intensities, and then the calculation of a cardinal statistic (the mean) to obtain average intensity scores. Another way of considering the data is to ignore this quantitative weighting of the various choice positions. Rather, we can simply count the frequency with which a given characteristic was selected in the first, second, third, fourth, or final cluster of three items from the original 15.

On the basis of this type of count, we have selected those characteristics which a plurality of the respondents selected as a first choice. This supplies a set of characteristics which can be thought of as *most popularly* associated with the respective modes of transportation. Tables 4 and 5 present those characteristics which meet this criterion; a plurality of respondents elected them to the first choice position.

The previous tables outline absolute information which is relatively free from a fixed framework or relative baseline. As a result, it is often difficult to assess the meaning of an intensity score, or a popularity rating. In Table 6, however, there is relative information. Here are listed all of the characteristics for which there were statistically significant differences in mean score, airplane versus train. Using the train as a rational baseline, we can thus note the feeling qualities which are more highly or less highly associated

TABLE 2
EMOTIONAL ASSOCIATIONS WITH TRAVELING BY AIRPLANE IN ORDER OF INTENSITY

Characteristic	Mean intensity of association	Characteristic	Mean intensity of association
*Significantly High Intensity Associations**		*Without Statistical Significance* (continued)	
Anxious	3.58	Neat	2.02
Nervous	3.45	Graceful	1.98
Fearful	3.36	Frank	1.98
Cheerful	3.30	Vain	1.98
Helpless	3.26	Social	1.96
Curious	3.13	Patient	1.87
Brave	2.98	Proper	1.83
Reckless	2.97	Sincere	1.83
Friendly	2.94	Bitter	1.83
Hasty	2.83	Original	1.79
Intelligent	2.75	False	1.79
Weary	2.74	Fierce	1.79
Calm	2.74	Decent	1.77
Prompt	2.64	Grateful	1.77
Practical	2.62	Kind	1.70
Silly	2.57	Shallow	1.68
Reasonable	2.53	Understanding	1.61
Powerful	2.51	Rude	1.60
Without Statistical Significance		*Significantly Low Intensity Associations**	
Quick	2.43	Savage	1.45
Strong	2.40	Slow	1.45
Loud	2.40	Gentle	1.38
Rough	2.38	Guilty	1.36
Lazy	2.36	Modest	1.32
Gallant	2.31	Ashamed	1.28
Foolish	2.30	Generous	1.23
Willing	2.30	Faithful	1.23
Smart	2.30	Cheap	1.04
Serious	2.26	Cruel	1.02
Exact	2.26	Jealous	0.94
Wise	2.23	Lying	0.92
Wild	2.21	Spiritual	0.91
Firm	2.21	Loyal	0.89
Peaceful	2.17	Evil	0.89
Careful	2.13	Religious	0.87
Clean	2.12	Wicked	0.68
Angry	2.11	Moral	0.66
Responsible	2.10	Tender	0.64
Honest	2.04		

*One per cent level of confidence.

TABLE 3
EMOTIONAL ASSOCIATIONS WITH TRAVELING BY RAILROAD IN ORDER OF INTENSITY

Characteristic	Mean intensity of association	Characteristic	Mean intensity of association
*Significantly High Intensity Associations**		*Without Statistical Significance* (continued)	
Cheerful	3.40	Gallant	2.04
Weary	3.34	Frank	2.02
Anxious	3.32	Shallow	2.00
Friendly	3.19	Serious	1.89
Calm	3.06	Exact	1.89
Nervous	3.02	Bitter	1.81
Slow	2.98	Brave	1.79
Proper	2.94	Smart	1.72
Lazy	2.91	Wise	1.72
Silly	2.91	Generous	1.70
Patient	2.89	Neat	1.70
Careful	2.85	Wild	1.68
Practical	2.79	Grateful	1.68
Modest	2.68	Rude	1.62
Responsible	2.62	Ashamed	1.62
Sincere	2.62	Gentle	1.57
Helpless	2.62	False	1.55
Reasonable	2.57	*Significantly Low Intensity Associations**	
Hasty	2.57	Powerful	1.47
Foolish	2.55	Strong	1.45
Firm	2.53	Quick	1.45
Without Statistical Significance		Clean	1.45
Intelligent	2.47	Graceful	1.39
Social	2.47	Jealous	1.38
Decent	2.47	Guilty	1.23
Rough	2.45	Faithful	1.21
Curious	2.43	Tender	1.15
Willing	2.36	Lying	1.11
Loud	2.32	Fierce	1.06
Understanding	2.32	Original	1.02
Kind	2.26	Loyal	1.00
Fearful	2.23	Savage	0.98
Honest	2.19	Wicked	0.96
Cheap	2.15	Moral	0.89
Prompt	2.13	Cruel	0.81
Peaceful	2.13	Evil	0.72
Reckless	2.11	Spiritual	0.65
Vain	2.11	Religious	0.53
Angry	2.09		

*One per cent level of confidence.

TABLE 4
POPULARITY OF ASSOCIATION OF VARIOUS FEELINGS WITH TRAVELING BY AIRPLANE

Characteristic	Percentage of respondents who chose the characteristic as a first choice to associate with air travel
Anxious	77
Nervous	68
Helpless	66
Fearful	62
Cheerful	49
Curious	47
Reckless	47
Friendly	47
Brave	45
Powerful	45
Hasty	40
Intelligent	40
Practical	40
Prompt	30
Quick	30

TABLE 5
POPULARITY OF ASSOCIATION OF VARIOUS FEELINGS WITH TRAVELING BY TRAIN

Characteristic	Percentage of respondents who chose the characteristic as a first choice to associate with rail travel
Cheerful	64
Weary	62
Anxious	60
Calm	57
Friendly	55
Silly	47
Nervous	47
Practical	45
Slow	45
Social	43
Proper	40
Patient	38
Lazy	36
Careful	36
Helpless	36
Responsible	34
Hasty	34
Curious	32

with the airplane. Only characteristics for which the mean difference was at least two standard errors of the mean are reported. Such significantly large differences could not be expected more than about two times in 100 on the basis of chance alone. Intensity as evidenced by the mean scores, and popularity as evidenced by the plurality of cases in the high score position, serve as the basis for an absolute analysis of the two media separately. However, these two measures are not independent estimates, but are closely related. The increased popularity of high score positions will obviously raise the intensity for a given item.

TABLE 6
EMOTIONAL FACTORS MORE/LESS INTENSELY ASSOCIATED WITH FLYING THAN WITH TRAVELING BY RAILROAD*

Characteristic		Mean difference
Air travel being		
	Less Slow	1.53
	Less Modest	1.36
	Less Cheap	1.11
	Less Proper	1.11
	More Fearful	1.07
	More Powerful	1.04
	Less Patient	1.02
	More Quick	0.98
	More Strong	0.95
	More Reckless	0.86
	More Brave	0.86
	Less Sincere	0.79
	More Original	0.77
	More Fierce	0.73
	Less Careful	0.72
	More Curious	0.70
	Less Understanding	0.70
	Less Decent	0.70
	More Clean	0.67
	More Helpless	0.64
	Less Weary	0.60
	More Graceful	0.59
	More Smart	0.58
	Less Kind	0.56
	Less Lazy	0.55
	Less Tender	0.51

*Statistically significant at the two per cent level of confidence.

D. CONCLUSIONS

In any multi-variate social research, where the empirical data attempts to keep pace with the complexity of the actual social phenomenon, a few rational generalizations often do injustice to the facts. Recognizing this limitation, we feel that the pattern of raw data outlines a large variety of factors only tentatively open to understanding at the present time. As a result, there are many more conclusions which could be drawn from the 69 statistically significant findings than the few outlined below.

First for the airplane. Most strongly evidenced is the stereotype that air transportation is associated with fear. The terms *anxious*, *nervous*, and *fearful* have the highest intensity and are most popularly related to air travel. The source of such fear may be partially evidenced by the high intensity and popular scoring of the term *helpless*. The loss of control and the feeling of incapacity which we commonly think of as helplessness are fairly rudimentary threats. There is a blind dependency upon forces beyond one's control and understanding during the process of flying. These forces, capable of destruction as well as transportation, would certainly enhance anxiety when it is also evident that one is helpless to influence them.

This association between flying and anxiety has not gone unnoticed in the general literature. Wegrocki (4) has considered the problem in terms of vulnerability of personality, the strength of the motivational element, and the nature of the social situation. Gatto (2) reports a number of case histories of air force personnel handicapped by such anxiety. From the point of view of military air combat, the problem is of extreme importance; and Holtzman and Bitterman (3) have summarized this literature, reporting a 263-item bibliography.

The second most noticeable stereotype appears centered around having to perform in the face of danger. There is a high intensity and popular scoring of the terms *reckless*, *brave*, and *powerful*. This constellation of feelings is probably related to the previous one on fear and helplessness. Undoubtedly flying in the face of fear combined with a feeling of helplessness would encourage feelings of reckless bravery.

The obvious speed of air transportation is seen in the high scoring of *hasty* and *prompt* and the popular scoring of *hasty*, *prompt*, and *quick*. Other evidences on the positive side of the ledger are reflected in the high intensity and high popularity scores of *cheerful*, *curious*, and *friendly*. In a more intellectual sphere, air transportation is also associated with feeling *intelligent*, *practical*, and *reasonable*. It is possible that these qualities represent the major forces establishing the air transportation media in the face of personal anxiety.

An overview of the data on rail travel suggests the following. First, rail travel appears to be related to a constellation of feelings which appear to be rather adult and responsible in nature. High scores appear for terms such as *proper*, *careful*, *practical*, *modest*, *responsible*, *sincere*, and *reasonable*. There appears to be a social acceptability and propriety associated with this means of transportation.

The relative slowness of rail as a means of transportation is apparently reflected in the high intensity and popular scoring of *weary*, *slow*, *lazy*, and *patient*.

Still another rail constellation appears to revolve around pleasurable gregariousness. *Cheerful* and *friendly* are both significantly intense and popular associations. *Social* is popularly scored high.

In addition, rail travel appears to have some quality of ridiculousness associated with it. The terms *silly* and *foolish* have high intensity scores; *silly* also appears in the popular category.

In the previous discussion, the absolute score values for air and rail travel were considered separately. A check on these hypotheses may be obtained through a relative analysis of the significant differences when comparing the scores for these two modes of transportation.

The quality of speed appears to produce the largest difference, as seen in the scoring of air travel as less *slow*, and to a lesser extent, as more *quick*, less *weary*, and less *lazy*.

Following this as a close second, is the differential scoring of air travel as less *modest*. Here there appears to be evidence of some asocial quality more closely related to air than to rail travel. When combined with the differential scoring of air travel as less *proper*, less *sincere*, less *understanding*, less *decent*, less *kind*, and less *tender*, there is a further suggestion that air travel has an aura of social impropriety attached to it.

A third cluster appears to be related to aggressiveness. Air travel scores as more *powerful*, *strong*, *reckless*, and *fierce*. If there is in fact a resultant feeling of personal aggressiveness, this may be one link to clarify the data on air travel producing socially improper feelings.

The danger and anxiety factor is also present in the relative analysis. There is a differential scoring of air travel as more *fearful*, more *brave*, more *helpless*, and less *careful*.

E. SUMMARY

By use of the Polydiagnostic method for eliciting associations, 69 statistically significant findings were obtained from a study of 47 subjects. These served to outline patterns of feelings and associations which may be related to traveling by air, and in comparison, traveling by rail. From these empirical data, a limited number of conclusions were tentatively drawn. First, air travel appears associated with a variety of feelings including anxiety, recklessness, impropriety, and speed. Rail travel, on the other hand, is associated with feelings which include propriety, slowness, pleasurable gregariousness, and a slight foolishness.

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TWO METHODS FOR GENERATING MATRICES OF FORMS OF GRADED SIMILARITY*[1]

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A. Introduction

There have been a number of recent attempts to specify the dimensions of similarity between two-dimensional forms (2, 3, 4, 5). The approach in each case has been to specify some objective, measurable property of the forms, such as the number of angles, information content, etc. On an *a priori* basis this property is expected to correlate with the perceived similarity between two forms. The present study offers two additional methods of generating forms, both of which yield objective measures having a rough correlation with the degree of similarity between forms. These methods concentrate on the differences or relationships between forms rather than on the specific properties of the forms per se, e.g., pairs of forms differing widely in their shapes may yield exactly the same objective measure by these methods. In addition, these two methods permit the generation of matrices of forms rather than a single continuum. As a consequence they generate sets of stimuli that make possible a wide range of studies in transfer of training and in form recognition.

B. Method I

The first method involves two phases: (*a*) an initial form is gradually distorted until it becomes a second specified form with the consequence that a whole row of intermediate forms is generated, and (*b*) this row of forms is then used to generate the matrix. The first phase involves the following considerations.

An outline of any two-dimensional form can be approximated by a set of points with straight lines drawn between them (1). If these points are moved continuously, but each at a different rate and in a different direction with respect to the center of gravity of that form, there is a continu-

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ous distortion of the original form. Depending upon the distances these points move, the perceptual difference between the original and the end form can be as small or as large as desired. Thus on an *a priori* basis one might expect that a measure of this distortion would correlate in a relatively direct manner with the similarity between forms. This is the basic assumption made in the present study.

If two outline forms are given, Form *A* and Form *Z*, each containing the same number of points and lines in its outline, one can be continuously distorted until it becomes the second. This is achieved by plotting each on the same set of coördinates with their centers of gravity coinciding. Each point on Form *A* then is connected by a straight line with a given point on Form *Z*. These lines indicate that if the points of Form *A* are moved in the directions and for the distances indicated by the lines, Form *A* is continuously distorted until it becomes Form *Z*. If during this movement each point is arrested after completing some fixed fraction of its path such as half the way between Form *A* and Form *Z*, and if these arrested points are joined so as to form an outline, there is created a new form intermediate between the two original ones. By reiterating this process for different fractions of the path, a large number of forms intermediate between the two original ones can be generated. This is the basic procedure employed in the present study.

If each form has N points, however, there are $N!$ ways in which the points of Form *A* can be paired with those of Form *Z*. Thus there are $N!$ different sets of intermediate forms because each pairing of points generates a different set of such forms. Consequently it is necessary to establish a rule as to which of these possible pairings is to be used. Similarly it is necessary to establish a rule for determining how the outlines of the intermediate forms are to be drawn. The above procedure only establishes the points, not the outlines, of the intermediate forms. With N points in a form, there are $(N-1)!$ ways in which they can be joined to form an outline. Consequently it is necessary to select one of these procedures for drawing an outline and preferably the same one for successive forms.

In generating the forms in Figure 1, the specific rules used in applying this first phase of Method I were as follows. On an 80 x 80 grid of 0.2 inch squares, 10 points were plotted by selecting the X and Y coördinates of each point from a table of random numbers. These points were joined by straight lines to form an outline, i.e., Form 1A in Figure 1. A second set of 10 points was selected at random by the same method and plotted on the same grid. These points were the basis for the outline of Form 6A in

Figure 1. The only restriction on this second set of points was that its center of gravity should coincide with that of the first set. The rule of pairing the points in the two sets was as follows. That one of the 10! possible pairings was selected that yielded the minimum sum of squared distances (*s.s.d.*) between paired points. This minimum *s.s.d.* between Forms 1A and 6A is 153.5 sq. in. After this pairing each of the resulting 10 paths between paired points was divided arbitrarily into five equal segments. The sets of end points for the successive segments were the basis for the outlines of Forms 2A, 3A, 4A, and 5A. The sum of squared distances between any two adjacent ones of these forms was 1/25th of the total, or 6.14 sq. in.

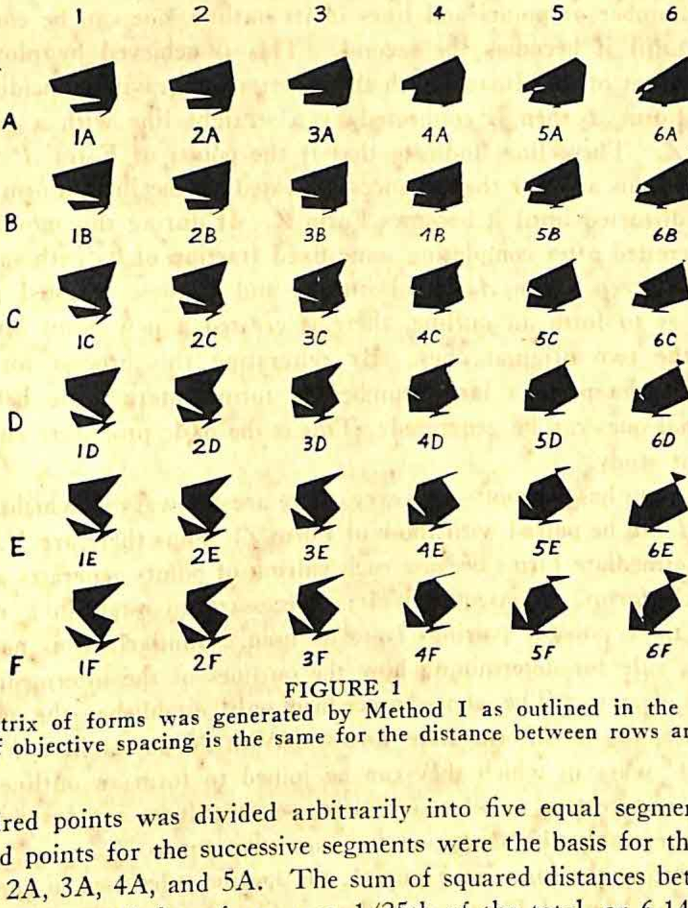

FIGURE 1

This matrix of forms was generated by Method I as outlined in the text. The measure of objective spacing is the same for the distance between rows and between columns.

The outlines of these intermediate forms and of Form 6A were determined by the following rule. If the points *a* and *b* were joined in the outline of Form 1A, then the corresponding points, i.e., those paired with them, in the other forms were joined by a straight line. While this rule provided an unambiguous criterion for drawing each outline, it had two unfortunate consequences. First it produced forms in which two sides of the outline "crossed over" in such a way as to generate two enclosed areas meeting at a common point as at the bottom of Form 5A. Secondly these "cross-overs" produced forms in which an enclosed area was surrounded by a second enclosed area as shown by the white space in the middle of Form 6A. Nevertheless the outlines were drawn and all enclosed areas were blackened except for those surrounded by a second enclosed area. These forms were then cut out, centered and mounted on 7 x 7 in. white cardboard to form the stimuli for Experiment 1.

This first phase of Method I can be summarized in a different way. Once the six forms in Row *A* of Figure 1 have been generated, the path followed by a given point in Form 1A, as this latter is distorted into Form 2A, can be represented by two increments, dx and dy. These are the increments that must be added respectively to the X and Y coördinates of a point in Form 1A to shift it to the position it occupies in Form 2A. Similarly if these same increments are added to this new point, they shift it to the position it occupies in Form 3A and so on. Thus the entire sequence of forms in Row *A* can be represented by two sets of numbers, the X and Y coordinates of the 10 points in Form 1A and the corresponding 10 pairs of dx and dy increments added to these points. These increments, of course, are determined by the rule that the points in Forms 1A and 6A are paired in such a way as to minimize the *s.s.d.* between them.

The second phase of Method I concerns the generation of the forms in the columns of Figure 1. To generate these, the 10 paths, represented by the dx and dy increments assigned each of the 10 points in Form 1A, were rotated 90° counterclockwise. This determined Form 1B in that the same rules as previously were used in drawing the outline. It should be clear that this procedure generates an entirely new form; it does not rotate the original one. Each of the 10 segmental paths was rotated about its own unique center, i.e., the point to which that specific dx and dy were added, not about the center of gravity of the form. By adding these rotated path segments to the points in Form 1B, Form 1C was produced and so on until Column 1 was completed. The other five columns were generated in a similar way.

This resulted in a matrix of forms with two unique properties. First, all adjacent forms are equally spaced irrespective of which row or column is involved as long as the *s.s.d.* of the 10 paths joining corresponding points in two adjacent forms is used as the objective measure of spacing. This follows from the fact that the same set of dx and dy increment pairs are added to each form to generate the succeeding one. Secondly there is an objective sense in which the columns can be said to be at right angles to the rows, and thus an objective sense in which two rows or columns can be said to be parallel.

Having generated a matrix of forms by this method, it is pertinent to ask about the various ways in which two adjacent forms can differ and about the extent to which the measure of the *s.s.d.* reflects these differences. The distortion of one form into a second may involve components of linear translation, of expansion, of rotation and of "pure" form distortion. If the same *dx* or *dy* is added to each of the 10 points, this results in a linear translation of the center of gravity of that form. If a *dx* and a *dy* are added to each point such that each point moves a proportional amount along the radius joining it with the center of gravity of the form, this results in an expansion or contraction of the form. If a *dx* and a *dy* are added to each point in such a way as to rotate each of the radii joining a point and the center of gravity by a constant amount, but not changing the distance between the point and the center of gravity, this results in a rotation of the form. Any of these distortions has the effect of changing all points in a like manner. In addition to these components, however, *dx* and *dy* components can be selected which result in shifts in each point that are independent of the shifts in any other. These latter appear to be most clearly related to the usual meaning of a "pure" distortion of form. Any one of these four types of distortion taken alone might well produce a different function relating perceived similarity to the *s.s.d.* measure of distortion. Nonetheless in this method, where the points for the two original forms are selected at random, any one or any combination of these four types of distortion may be involved in the differences between two adjacent forms.

One advantage of the *s.s.d.* as an objective measure of spacing is that it permits the evaluation of the contribution of each of these types of distortion in any matrix of forms. There is, of course, no translation effect in the present forms in the sense that the center of gravity of each form is centered on a 7 x 7 in. card. The contributions of the expansion, rotation and "pure" distortion effects can be determined by partitioning the *s.s.d.* separating two adjacent forms by means of a least square method. In this partitioning the expansion and rotation components are not independent, i.e., the relative amount each contributes to the total *s.s.d.* depends upon whether the form is first expanded and then rotated or conversely. Nonetheless by simultaneously rotating and expanding the form, the joint contribution of these two effects can be determined, and this is independent of the remainder term that measures "pure" distortion effects. This "pure" distortion effect accounts for 88.8 per cent of the total *s.s.d.* between adjacent forms in Figure 1.

C. EXPERIMENT 1

1. *Procedure*

To check on the relationship between perceived similarity and the objective measure of distortion, i.e., the *s.s.d.* between adjacent forms, a recognition experiment was designed using the forms in Figure 1. This required the *S* to identify that one of a set of forms that most closely resembled a a stimulus form he had seen just a moment before. A horizontal row of six "identifiers" (*Id*) consisting of the six forms in a given row or column of Figure 1 was fastened to a wall 6 ft. in front of the seated *S* with the midpoints of the forms 5 ft. from the floor. The six *Id* forms were displayed in the standard left-right order, i.e., the order in which they had been generated. With a given set of *Id* in place, the 36 stimulus forms in Figure 1 were presented one at a time in random order, each with a 2-sec. exposure. They appeared directly under the middle of the *Id* row. These latter, however, were visible at all times. During the 8 sec. between stimulus exposures, the *S* indicated on a printed sheet which of the six *Id* forms most closely resembled the stimulus he had just seen. The assumptions justifying the use of this technique were (*a*) that the variability in these judgments would increase as a direct function of the separation, measured in *s.s.d.* units, between the stimulus form and the *Id*, and (*b*) that the same function would be found when the rows and when the columns were used as *Id*, assuming that the rows and columns were equally spaced psychologically.

A completely balanced design would have required each *S* to make 432 judgments, judging each of the 36 stimulus forms against each of the 12 possible *Id* sets, i.e., the six rows and six columns of Figure 1. In a 50-min. period, however, *S* could make only 144 judgments when a 5-min. rest pause was permitted after each series of 36 judgments. Consequently the design employed only required *S* to compare the 36 stimulus forms first with one *Id*, then with a second, a third, and a fourth. These four *Id* consisted of two rows and two columns from Figure 1. Twelve such groups of four *Id* were chosen such that each row and each column of Figure 1 appeared once in each of the four temporal positions of presentation, and such that half the orders had the sequence of row, column, row, column and half had the reverse sequence. In addition 16 different random orders of the 36 stimulus forms were constructed with the restriction that a form from each row and column would occur in each successive set of six stimuli. These stimulus orders were assigned at random to the groups of *Id*. This design is shown in Table 1. The *S*s were 60 students from an introductory psychology course. They were run in groups of five, all members of a group being treated exactly alike. As each *S* made judgments for only one-third of the possible *Id*, i.e., four of the 12, there were only 20 judgments available on each stimulus-*Id* combination even though there were 60 *S*s.

TABLE 1*
DESIGN FOR EXPERIMENT 1

	Order							
	First		Second		Third		Fourth	
Group	Id.	Stim.	Id.	Stim.	Id.	Stim.	Id.	Stim.
I	A	# 1	3	# 2	F	# 9	4	#10
II	B	# 3	4	# 4	E	#11	5	#12
III	C	#12	5	#11	A	# 4	2	# 3
IV	D	#10	2	# 9	C	# 2	6	# 1
V	E	# 9	6	#10	D	# 1	1	# 2
VI	F	# 4	1	# 3	B	#12	3	#11
VII	3	# 5	A	# 6	2	#14	E	#13
VIII	6	# 6	B	# 7	3	#15	C	#16
IX	2	#16	C	#15	4	# 6	F	# 7
X	5	#14	D	#13	1	# 6	B	# 5
XI	1	#13	E	#14	6	# 5	D	# 6
XII	4	# 7	F	# 6	5	#16	A	#15

*In this table the capital letters in the *Id* columns above represent the rows in Figure 1 and the numbers represent the columns in Figure 1. The numbers in the stimulus columns of this table represent one of the 16 random orders of stimulus presentation. Five *S*s were assigned to each group.

2. *Results*

The data were scored in the following way. When a row of Figure 1 constituted the *Id*, the forms were numbered 1 to 6 from left to right, and when a column constituted the *Id*, they were numbered 1 to 6 from top to bottom. This assumes that the spacing between adjacent forms is one unit, but any means or variances computed on this basis can be readily translated into *s.s.d.* units. As each of the 36 stimulus forms was judged against each of the 12 *Id* sets, a separate distribution of the 20 judgments on each stimulus-*Id* combination was tabulated. The mean and variance of each of these distributions was computed making 432 of each.

These were summarized as follows. When Row *A* of Figure 1 was the *Id*, Form 1A in Column 1 was simultaneously a stimulus and a member of the *Id*. Similarly when Row *B* was the *Id*, Form 1B in Column 1 was simultaneously a stimulus and a member of the *Id*. Each of these represents a separation between stimulus and *Id* of zero units. Considering all six rows as *Id*, there were six occasions on which there was zero separation between the stimuli in Column 1 and the *Id* against which they were judged. This gave six distributions each based on 20 judgments. The six means of these distributions were averaged as an index of the placement of stimuli in Column 1 for a stimulus-*Id* separation of zero units irrespective of the specific row *Id* involved. This averaging was done in turn for the stimuli in Columns 2, 3, etc. These averages form the top row in Table 2. This averaging process was repeated using Column *Id* and the stimuli in the rows. The resulting averages are shown in the second row of Table 2.

TABLE 2*

AVERAGE PLACEMENT OF STIMULI WITH RESPECT TO *ID* IN EXPERIMENT 1

Separation of Stim.-Id.	Type of Id.	No. stim. averaged	Column or row position of stimuli						Aver. σ^2_m	Aver. of means
			1 or A	2 or B	3 or C	4 or D	5 or E	6 or F		
0	Row	6	1.28	1.86	2.90	4.02	4.94	5.83	.010	3.47
	Col.	6	1.17	1.97	3.03	4.01	5.00	5.87	.024	3.51
1	Row	10	1.47	1.94	2.81	3.98	4.90	5.52	.051	3.44
	Col.	10	1.42	1.90	3.18	4.08	4.82	5.40	.099	3.47
2	Row	8	1.84	2.23	2.93	3.95	4.56	5.09	.118	3.43
	Col.	8	1.44	2.23	3.40	4.06	4.58	5.41	.185	3.52
3	Row	6	2.18	2.61	3.25	3.74	4.28	4.52	.319	3.43
	Col.	6	1.99	2.28	3.19	3.91	4.53	5.09	.552	3.50
4	Row	4	3.02	3.22	3.30	3.89	3.73	4.35	.532	3.59
	Col.	4	2.34	2.45	3.20	3.90	4.69	5.34	.680	3.65
5	Row	2	3.32	2.92	3.25	3.45	3.88	3.95	.350	3.46
	Col.	2	2.28	2.68	3.20	3.88	4.20	4.68	.583	3.48

Variances in Experiment 1

Separation of Stimuli and Id

Type of Id.		0	1	2	3	4	5
Row	Aver. Var.	.21	.65	1.30	2.21	2.65	2.64
	σ^2 of Var.	.022	.237	.491	.894	.963	1.905
Col.	Aver. Var.	.21	.61	1.08	1.76	1.69	2.15
	σ^2 of Var.	.048	.143	.344	.961	1.129	.902

*In the top part of this table when a row is an *Id*, the stimuli come from the columns. When a column is an *Id*, the stimuli come from the rows. The values in the column of this table labeled average σ^2_m were computed as follows. Each of the averages in the main part of the table was based on a sample of means. For each of these samples, a σ^2_m was computed. Six of these were averaged to form the corresponding value in the average σ^2_m column.

When Row *B* was the *Id*, there were two stimuli in Column 1, Forms 1A and 1 C, that were separated from the *Id* by one unit each. Considering each of the six rows in turn as *Id*, there were 10 combinations of stimulus and *Id* in Column 1 separated by one unit. The means for these 10 distributions were averaged, first for Column 1 stimuli, then for Column 2, etc. The resulting averages are shown in the third row of Table 2. This process was repeated using columns as *Id* and the results are shown in the fourth row of the table. The remainder of this table is to be interpreted in a like manner. It should be noted that the averages in this table are intercorrelated in a complex way: first because each *S* contributed to only a third of the distributions, secondly because each set of *S*s contributed to a different third, and thirdly because each stimulus form and each *Id* entered into several distributions but each time in a different combination. Consequently no precise statistical analyses were attempted with these data. They were used only to draw rough inferences about the relationship between perceived similarity and the *s.s.d.* measure of spacing used in generating the rows and columns in Figure 1.

The averages in Table 2 demonstrate several points. First the stimulus averages have exactly the same ordering as the corresponding *Id* forms even with as much as three units of separation between stimuli and *Id*. With greater separation the averages for Row *Id* show inversions in order but not for Column *Id*. This suggests that with relatively large stimulus-*Id* separations there is more accurate placement for Column *Id* than for Row *Id*. Secondly, as shown by the extreme right column of Table 2, the mean of each line tends to be 3.5 irrespective of the degree of separation. This indicates that there is no consistent tendency to prefer one end of the *Id* continuum over the other in making judgments. Finally it is apparent that as the separation increases there is an increasing tendency to match the stimuli in Columns 1 and 6 (and in Rows *A* and *F*) with less extreme *Id* forms. This central tendency effect is to be expected if the amount of "guessing" increases as a function of increased separation. That this is the case is indicated by the increasing variance of the means with increasing separation as shown in the second column from the right in Table 2. However, this central tendency effect appears more pronounced with Row *Id* than with Column *Id* at the larger separations. Considering separations of zero, one, and two units, there are 18 pairs of row-column averages. In 10 of these the row average has a value closer to 3.5, the midscore of the six *Id* forms, than does its corresponding column average. This is a value well within the range of chance on the hypothesis that the central tendency effect is the same for Row and Column *Id*. But for separations of three, four, and five units, all 18 row averages are closer to 3.5 than are the corresponding column averages. This latter would occur less than 1 per cent of the time if the central tendency effect was the same for Row and Column *Id*. This evidence, plus the inversions in the ordering of the averages for Row *Id*, indicates that the rows and columns in Figure 1 are not equally spaced psychologically, at least when more than two or three units separate the stimuli and *Id*.

The 432 variances for the original distributions were summarized in the same manner as the means. In this instance, however, the average variances were not segregated by column (or row), only by degree of separation between stimuli and *Id*. These averages, as well as the variances of the variances, are shown at the bottom of Table 2. If the *S*s were guessing and distributed their choices equally among the six *Id* forms, these variances would have a maximum value of 2.92. However if the *S*s had any tendency when guessing to select the middle forms of the *Id* more frequently than the end ones, the maximum value would be less. With this in mind it is not surprising that for both Column and Row *Id* the average variances tend to increase almost linearly up to three units of separation and thereafter show fluctuations and inversions. Although the average variances for Row and Column *Id* are identical at zero separation, there is a suggestion that the averages for Row *Id* increase more rapidly with increasing separation than those for Column *Id*. Because of the intercorrelations in these data and because the variances of the variances also increase with the degree of separation, it is impractical to fit regression lines. If, however, the difference between the two averages at five units of separation is ignored, on the grounds that the average variance for Row *Id* has reached an asymptote, it is clear that there is a systematic increase in the differences between these average variances with increasing separation. This perfect progression in the size of the differences over five intervals would occur less than 1 per cent of the time if the two slopes were equal. Thus these data also indicate that the psychological spacing of rows and columns in Figure 1 is not equal.

D. EXPERIMENT 2

1. *Procedure*

A second experiment was run using the forms of Figure 1. Its twofold purpose was to determine (*a*) how precisely the results in Experiment 1 could be duplicated, and to determine (*b*) the effect of displaying the six forms of a given *Id* in random order from left to right rather than in the standard order, i.e., the order in which they were generated. Only the rows of Figure 1 were used as *Id*. Otherwise the design was basically the same as in Table 1, if the term "rows randomly ordered" is substituted in it wherever Column *Id* occurs. Thirty *S*s were run in groups of five. Consequently only six of the sets of *Id* listed in Table 1 were used. The other main difference was that half the *S*s had two *Id* with random ordering followed by two *Id* with standard ordering and the rest had the converse. The random ordering of the six forms in a given *Id* was determined by the use of two 6 x 6 Latin squares. All other procedural aspects were the same as in Experiment 1. It should be borne in mind, however, that with 30 *S*s, only 10 judgments were made on each stimulus-*Id* combination.

2. *Results*

The data were tabulated and summarized as in Experiment 1. The averages of the means for the various stimulus-*Id* separations are shown in Table 3. There are no consistent differences between the averages for the stand-

TABLE 3

AVERAGE PLACEMENT OF STIMULI WITH RESPECT TO *Id* IN EXPERIMENT 2

Separation of Stim.-Id.	Type of Id.	No. stim. averaged	Column position of stimuli						Aver. σ^2_m	Aver. of means
			1	2	3	4	5	6		
0	Stand.	6	1.41	1.70	2.37	3.97	4.93	5.82	.030	3.43
	Rand.	6	1.38	1.88	2.78	3.87	4.90	5.63	.083	3.41
1	Stand.	10	1.60	1.92	2.86	3.78	4.92	5.40	.096	3.41
	Rand.	10	1.62	1.92	2.87	4.03	4.98	5.46	.092	3.48
2	Stand.	8	1.98	2.36	3.16	4.09	4.49	5.00	.233	3.51
	Rand.	8	2.05	2.14	2.85	4.15	4.46	4.99	.268	3.44
3	Stand.	6	2.10	2.62	3.53	3.83	4.45	4.85	.321	3.56
	Rand.	6	2.68	3.05	3.28	4.08	4.15	4.62	.463	3.64
4	Stand.	4	2.60	3.12	3.17	3.53	3.90	4.75	.791	3.51
	Rand.	4	2.70	2.87	3.20	4.27	4.05	4.88	.412	3.66
5	Stand.	2	2.70	3.25	3.30	3.85	4.40	3.85	.539	3.56
	Rand.	2	2.85	3.60	3.60	3.05	4.65	3.55	.098	3.55

Variances in Experiment 2

Type of Id.		Separation of Stimuli and Id.					
		0	1	2	3	4	5
Standard	Aver. Var.	.37	.65	1.39	1.99	1.83	2.28
	σ^2_m of Var.	.137	.324	1.032	1.257	.993	1.843
Random	Aver. Var.	.43	.85	1.44	2.20	1.92	1.93
	σ^2_m of Var.	.128	.428	1.311	1.937	.958	1.647

ard and the random *Id* conditions. The averages for both show exactly the same ordering as the corresponding *Id* forms up to and including three units of separation. The random order shows an inversion at four units and both at five units. Both show a central tendency effect with increasing separation, but there is no evidence that it is any more marked with the random than with the standard order. The averages for the random order are closer to 3.5 than are those of the standard order in 21 of the 36 contrasts, a division readily accounted for by chance. Thus in terms of these data on the average placement of stimuli with respect to the *Id* forms there is no evidence that the type of ordering of the forms within *Id* has any influence on the resulting judgments.

When the averages for the standard order of this experiment are contrasted with the row means in Experiment 1, which also had the *Id* in standard order, the most obvious difference is the consistently larger variances of the means (extreme right column in Table 3) in the present experiment. This occurs at all but one of the degrees of separation. This is to be expected, however, because the means of the present study are based on only half the number of judgments involved in Experiment 1. Again while both show increasing central tendency effects with increasing separation, there is no evidence that they differ in this respect. The averages of the present study are closer to 3.5 than are those of Experiment 1 in 19 of the 36 contrasts, a division readily accounted for by chance. Consequently these data suggest that these relationships between stimulus placement and stimulus-*Id* separation can be duplicated relatively closely with small samples.

The averages of the variances for both the standard and random orders of *Id* in the present study are shown at the bottom of Table 3. In each case, except at five units of separation where they presumably are approaching an asymptote, the average of the variances for the random order is larger than for the standard order. These differences do not increase, however, with increasing separation. The tentative implication is that the regression of average variance on separation is the same with standard and random *Id*, but that the average scattering of judgments for any given stimulus-*Id* combination may be slightly higher under the latter condition. This would be expected if the random ordering of the *Id* increased the difficulty of search behavior by a constant amount for each judgment.

When the averages of the variances for the standard ordering of *Id* in Table 3 (present study) are compared with those for Row *Id* in Table 2 (Experiment 1) at various separations, no consistent differences are apparent. What differences do occur are of small magnitude compared with the corresponding variances of variances. The fact that these latter are consistently larger in Table 3 than in Table 2 is to be expected because of the smaller number of judgments involved in the present study. Thus these data also indicate that the results of Experiment 1 can be duplicated with relatively small samples.

E. METHOD II

The second method used for generating a matrix of forms is basically a generalization of Method I. In the latter it was shown that once the pairs of *dx* and *dy* increments of the original form have been determined, then an entire row of forms can be summarized by two sets of numbers, the set of *X* and *Y* coördinates for the points of the initial form and the set of *dx-dy* increments that are added to the points. In the present method, the *X* and *Y* coördinates of the 10 points in the original form again were determined by a table of random numbers and these were drawn on an 80 x 80 grid of 0.2 in. squares. Then instead of determining a second form and a rule for distorting the first form until it became the second, the procedure was to go directly to the determination of the increments. This was done by writing down 10 numbers in the arbitrary range from —0.6 in. to +.06 in., including these end points, such that the sum of the 10 numbers was zero. These were assigned at random to the 10 points of the original form and became the *dx* increments. The *dy* increments were determined by a second random assignment of these 10 numbers. These increment pairs were added to the points of the original form to determine the second form in a row. Then they were added to the latter to determine the third, and so on until a row of 21 forms had been generated. The restriction of the sum of the *dx* and of the *dy* increments to zero ensured that the center of gravity of these successive forms would not change. An arbitrary outline was drawn for the initial form. Then in drawing the outline of the other forms, the same rule was applied as in Method I, i.e., if two points were joined by straight line in the outline of the initial form the corresponding two points in all other forms were so joined.

Having generated a row of forms in this way, each of the *dx* and *dy* increments of the initial form then were multiplied by two. The 10 paths determined by these pairs of increments were rotated 90° counterclockwise, just as in Method I, and used to generate six forms in each column. As a result of multiplying each increment by two before the rotation, the adjacent forms in a column were spaced twice as far apart as were adjacent forms in a row as measured by the square root of the *s.s.d.* between adjacent forms. The resulting matrix of forms with 21 in a row and six in a column is shown in Figure 2.

In Figure 2 the *s.s.d.* between adjacent forms in a row, i.e., between columns, is 0.712 sq. in. and between adjacent forms in a column, i.e., between rows, it is 2.848 sq. in. The corresponding square-roots of these quantities ($\sqrt{s.s.d.}$) are 0.844 in. and 1.688 in., thus indicating that in terms of this unit of measurement the spacing between columns is only half that between rows. (In contrast the spacing in terms of $\sqrt{s.s.d.}$ between rows and columns in Figure 1 is 2.478 in.) As in Method I the *s.s.d.* between forms in the present matrix was partitioned into two parts, that due to the expansion-rotation component and that due to "pure" distortion. The "pure" distortion component accounted for 85.5 per cent of the total sum of squares.

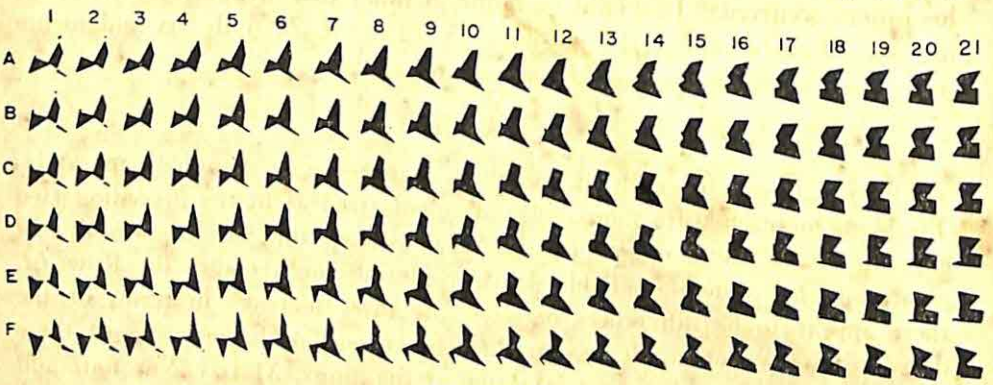

FIGURE 2

This matrix of forms was generated by Method II as outlined in the text. The measure of objective spacing between columns is only half that between rows.

F. Experiment 3

1. *Procedure*

The forms in Figure 2 were used in a third experiment whose twofold purpose was to determine (*a*) whether a simple relationship between the objective measure of spacing and perceived similarity could be found even though the rows and columns of the matrix were differentially spaced, and to determine (*b*) if this relationship remained constant throughout various sections of a large matrix. Consequently the forms in Figure 2 were divided into three 6 x 6 matrices by taking Columns 2-7, 8-13 and 14-19. These are referred to as Matrix 1, 2, and 3 respectively. In most other respects the design and procedure of the present study was the same as in Experiment 1. However, each *S* had two of his *Id* from a given matrix and one from each of the other two. This was arranged so that neither the two Row *Id* nor the two Column *Id* came from the same matrix. There were 54 *S*s run in nine groups of six each. The sets of four *Id* assigned to these groups were counterbalanced, in so far as possible, with respect to the temporal order in which matrices, Row and Column *Id*, and the random stimulus orders occurred. It should be borne in mind that with 54 *S*s each having only four *Id* out of the possible 3 x 12 or 36 *Id*, only six judgments were made on each stimulus-*Id* combination.

2. *Results*

The judgments for each of the three matrices were handled separately. The data for each were tabulated and summarized as in the preceding two experiments. The averages of the mean values for various stimulus-*Id* separations are shown in Table 4. Considering the averages for Row *Id*, there appear to be differences between the three matrices in terms of the degree of separation needed to produce inversions in the ordering of these averages. Matrix 1 shows an inversion at five units, Matrix 2 at four and five units, and Matrix 3 at three, four, and five units. Similarly for Column *Id*, Matrix 2 shows an inversion at five units, Matrix 3 at four and five units, and Matrix 1 at three, four, and five units. In interpreting these results it should be borne in mind that the spacing between rows is twice that between columns, but that the six forms making up a Row *Id* are closer together than the six forms making up a Column *Id*.

When pairs of matrices are contrasted with respect to central tendency effects, the row averages for Matrix 3 are closer to 3.5 than are those of Matrix 2 in 25 of the 36 possible contrasts and closer than those of Matrix 1 in 27 of the 36. On the hypothesis that these discrepancies from an equal split are due to chance, the first is significant at the 2 per cent and the latter at the 1 per cent level of significance. Similarly the averages of Matrix 2 are closer to 3.5 than are those of Matrix 1 in 24 of the 36 contrasts (5 per cent level). These data and those for inversions in ordering among the averages for Row *Id* suggest that with increasing separation the placement of stimuli is most accurate in Matrix 1, less accurate in Matrix 2, and least accurate in Matrix 3. This in turn indicates that the perceived spacing between rows may increase from Matrix 1 to Matrix 3. When this analysis for central tendency effects is made for Column *Id*, the averages for Matrix 1 are closer to 3.5 than are those of Matrix 2 in 29 of the 36 contrasts (1 per cent level), and closer than those of Matrix 3 in 26 of the 36 contrasts (1 per cent level). There is no clear evidence, however, that Matrix 2 and 3 differ in this respect. These data and those for inversions of ordering among the averages for Column *Id* suggest that the per-

TABLE 4
AVERAGE PLACEMENT OF STIMULI WITH RESPECT TO *Id* IN EXPERIMENT 3

	Separation Stim.-Id.	Matrix	No. stim. averaged	Column position of stimuli						Aver. σ^2_m	Aver. of means
				1	2	3	4	5	6		
Rows as Id.	0	1	6	1.17	2.22	2.83	4.05	5.06	5.61	.080	3.49
		2	6	1.28	1.86	2.83	3.72	4.94	5.64	.067	3.38
		3	6	1.25	2.03	2.75	3.86	4.83	5.72	.043	3.41
	1	1	10	1.45	2.02	2.92	4.20	5.00	5.40	.182	3.50
		2	10	1.67	2.02	2.63	3.95	4.82	5.37	.302	3.41
		3	10	1.87	2.30	3.23	3.52	4.40	5.15	.514	3.41
	2	1	8	1.77	2.19	3.19	4.08	4.90	5.44	.319	3.60
		2	8	1.81	2.00	2.63	3.35	4.42	5.17	.403	3.23
		3	8	2.42	2.85	3.54	3.73	4.27	4.44	.532	3.54
	3	1	6	1.78	2.56	3.11	3.78	4.78	4.81	.580	3.47
		2	6	1.94	2.36	2.69	2.97	4.00	4.42	.498	3.06
		3	6	2.89	2.70	3.39	3.97	3.83	4.28	.557	3.51
	4	1	4	1.87	2.46	3.46	4.17	4.71	5.08	.818	3.62
		2	4	1.75	1.83	3.00	2.46	3.58	5.04	.648	2.94
		3	4	2.83	3.25	2.79	3.04	4.33	4.21	.412	3.41
	5	1	2	2.25	2.83	3.00	4.03	3.67	4.17	.982	3.32
		2	2	2.75	1.58	3.92	2.92	3.50	3.25	.367	2.99
		3	2	1.44	2.15	2.33	3.36	2.50	3.71	1.677	2.58
				Row Position of Stimuli							
Columns as Id.	0	1	6	1.22	2.06	3.22	4.11	4.86	5.72	.082	3.53
		2	6	1.00	2.03	3.11	4.14	5.00	5.92	.015	3.53
		3	6	1.06	2.06	3.03	3.92	5.08	5.97	.010	3.52
	1	1	10	1.68	2.32	3.23	3.92	4.73	5.33	.228	3.54
		2	10	1.12	1.95	3.02	4.07	5.10	5.78	.054	3.51
		3	10	1.15	1.87	2.87	3.88	4.92	5.93	.040	3.44
	2	1	8	2.00	2.31	2.83	3.69	4.46	5.08	.250	3.40
		2	8	1.38	2.12	3.02	4.15	5.21	5.88	.109	3.63
		3	8	1.46	2.02	2.94	3.92	4.92	5.73	.126	3.50
	3	1	6	2.39	2.17	3.11	3.45	4.28	4.69	.398	3.35
		2	6	1.56	2.08	2.83	4.33	5.11	5.78	.156	3.62
		3	6	2.22	2.22	2.75	4.20	4.95	5.81	.165	3.69
	4	1	4	1.71	2.67	2.92	3.04	4.58	4.46	.380	3.23
		2	4	1.79	2.38	3.17	4.25	4.71	5.21	.403	3.58
		3	4	2.71	2.04	3.21	4.38	4.92	5.21	.220	3.74
	5	1	2	2.42	2.42	2.67	3.75	4.92	4.25	.140	3.41
		2	2	2.92	2.58	3.42	4.25	5.00	5.92	.793	4.02
		3	2	3.17	2.17	3.50	2.50	4.08	5.50	.303	3.49

ceived spacing between columns is greater in Matrix 1 than it is in the other two matrices.

The averages of the variances for each of these three matrices are shown in Table 5. They are listed separately for Row and Column *Id* at various stimulus-*Id* separations. Considering the averages for Row *Id*, there appear to be consistent differences between the three matrices. In five of the six possible comparisons, the averages for Matrix 3 are larger than for Matrix 1 and larger than for Matrix 2. In turn the averages of Matrix 2 are larger than for Matrix 1 in five of the six comparisons. While no one of these differences by itself is significant, nonetheless the three matrices are ordered just as for the central tendency effect, i.e., Matrix 3 shows the highest variability and Matrix 1 the least. Considering the averages for Column *Id*, there again appear to be consistent differences between the three matrices. The averages for Matrix 1 are larger than those of Matrix 2 in six of the six comparisons and larger than those of Matrix 3 in four of the six. In turn the averages for Matrix 3 are larger than those of Matrix 2 in five of the six comparisons. Thus with Column *Id* the three matrices are ordered just as for the central tendency effect with Matrix 1 the most variable and Matrix 2 the least.

TABLE 5
VARIANCES IN EXPERIMENT 3

Type of *Id*	Matrix		Separation of stimuli and *Id*					
			0	1	2	3	4	5
Row	1	Aver. Var.	.20	.54	.86	1.56	1.16	2.23
		σ^2 of Var.	.116	.291	.519	1.600	1.085	1.346
	2	Aver. Var.	.32	.69	1.07	1.78	1.40	1.89
		σ^2 of Var.	.061	.236	.871	1.414	.689	1.885
	3	Aver. Var.	.35	.97	2.18	1.99	1.98	1.64
		σ^2 of Var.	.128	.798	.990	1.369	1.469	1.091
Col.	1	Aver. Var.	.31	.80	1.32	1.59	1.47	1.98
		σ^2 of Var.	.076	.569	.842	1.089	.993	1.964
	2	Aver. Var.	.09	.23	.41	.64	1.40	1.40
		σ^2 of Var.	.014	.090	.299	.535	1.066	1.263
	3	Aver. Var.	.13	.20	.45	.83	1.55	2.19
		σ^2 of Var.	.062	.125	.225	.559	1.152	1.414

In all the above computations of average variances the spacing between adjacent forms within a given *Id* was taken as a unit quantity. But as the adjacent forms in Column *Id* are spaced twice as far apart as are the adjacent forms in Row *Id*, when viewed in terms of the objective measure of spacing used in Method II, a direct comparison between the average variances for these two types of *Id* can be made only after allowance has been made for this differential spacing. Similarly in taking into account the stimulus-*Id* separation, allowance must be made for the fact that the spacing between rows is twice that between columns. Consequently the $\sqrt{s.s.d.}$ between adjacent forms was taken as the unit for recomputing all values in Table 5. Corresponding averages for each of the three matrices then were combined, despite known differences between them, in order to obtain a rough picture of the relationship between the absolute size of the variances and the stimulus-*Id* separation. The resulting averages of the variances for Row and Column *Id* at various stimulus-*Id* separations are shown in the left hand panel of Figure 3.

At zero separation the average variance for Column *Id*, which have the larger spacing between the six forms making up the *Id*, is larger than for the Row *Id*. This holds for each matrix alone as well as for the combined matrices. This suggests that the smaller the spacing between *Id* forms the more readily the *S* can discriminate between them in judging which most closely resembles a given stimulus form. Similarly the rate of increase in average variance with increasing stimulus-*Id* separation is greater with Column than with Row *Id*. Again this is true for each matrix alone as well as for the combined matrices. But in interpreting this it must be borne in mind that, because of the greater spacing between forms in the Column than in the Row *Id*, the maximum possible variance for the former is 8.32 sq. in. whereas in the latter it is only 2.08 sq. in. This is on the assumption that the judgments are equally distributed between the six *Id* forms. (As indicated previously the empirically obtainable maximum variances are probably less than this.) Thus it would appear that the variability in judging the resemblances between stimuli and *Id* forms at zero separation, as well as the rate of increase in this variability with increasing separation, is some function of the maximum possible variability for these *Id*.

As a rough check on the above possibility, the average variances in the left hand panel of Figure 3 were expressed as percentages of the maximum possible variance in each case. These are plotted in the right hand panel of Figure 3. The agreement between the two curves both for intercept values and slopes is quite close. However, all the data in Figure 3 must be taken only as a tentative suggestion of the possible relationships between the variables of spacing within *Id*, of stimulus-*Id* separation, and of the average value of the resulting variances. Not only are there significant differences between the three matrices that have been combined in Figure 3, but these relationships have only been tested on this specific set of forms.

G. Discussion

The major positive conclusions that can be reached from these three experiments are as follows:

1. Either of the two methods for generating forms that have been used in the present study provides a convenient way of completely describing a given set of forms. Not only does it permit an exact duplication of any set, but it makes possible the generation of innumerable forms by a consistent method. The generation and description are completely specified by two sets of numbers, the coördinates of the initial form and the *dx-dy* increments added to them, and by two rules, one for drawing the outlines and a second for determining the degree of rotation of the paths.

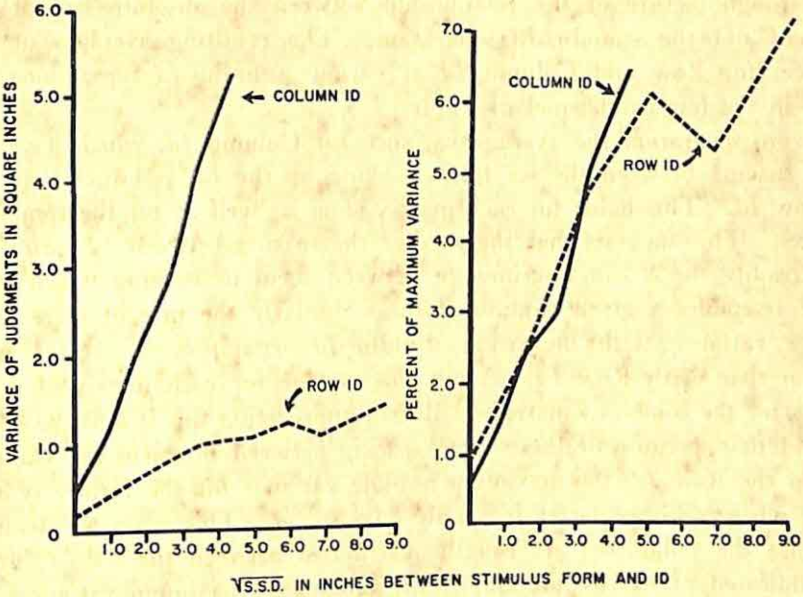

FIGURE 3

The above graphs are based on the results from the forms in Figure 2. They show the relationship between the average variability in the placement of a stimulus form as the measure of objective distance between the stimulus form and the *Id* increases. The panel on the left is for the actual variabilities obtained, that on the right for the variabilities expressed as a percentage of the maximum possible variability when the judgments are distributed equally between the six *Id* forms.

2. The perceptual ordering of the forms generated by either of these methods can generally be specified *a priori* [on the average]. The perceptual ordering will be the same as the order in which they are generated.

This statement is based on the assumption that a stimulus form closely resembling an *Id* form is placed with little uncertainty but that a stimulus form having little resemblance to the *Id* forms is placed with considerable uncertainty. Granting this, the fact that in each of the three experiments the average of the variances is an increasing monotonic function of the degree of separation between the stimulus and the *Id* (as measured by the *s.s.d.*) indicates a close correlation between the perceptual ordering and the order of generation. This conclusion, however, must be restricted to the present type of recognition task. It remains to be proven that such a correlation would obtain in stimulus generalization or in learning studies.

3. The comparison between Experiments 1 and 2 indicates that an obtained correlation of the above type can be reliably duplicated with relatively small samples of *S*s and is independent of whether or not the forms constituting the *Id* are in standard or in random order.

On the other hand it seems quite clear from the results of these experiments that no simple relationship exists between the perceptual spacing of these forms and their objective spacing as measured by the *s.s.d.* In Experiment 1 different results are obtained depending upon whether the rows or columns of Figure 1 are used as *Id*. In terms of the *s.s.d.* measure, however, these have exactly the same spacing. Again in Experiment 3 differential results are obtained from each of the three sections of a large matrix even though the objective measure of spacing is the same throughout. Thus the obtained relationship between perceptual and objective spacing depends upon the specific forms involved. Consequently in any study demanding perceptually equal spacing of the forms an empirical scaling procedure must be used even though the forms are generated by either of the present methods.

It should be clear that all the above conclusions are based upon average results. Because of the experimental design employed and the small number of judgments obtained, no attempt was made in any of the experiments to scale the difference between two pairs of rows or columns within a matrix, e.g., comparing the difference between Rows *A* and *B* with that between *C* and *D* in Figure 1. All differences of this sort were averaged together in considering the stimulus-*Id* difference of one unit. Consequently it is quite apparent that, if even these average relationships fail to give constant results for different sections of the same matrix, there is no likelihood that more analytic comparisons would show a constant relationship between perceptual and objective spacing.

In retrospect several suggestions can be made for improving the nature of the forms generated by either of the methods employed in the present study. In both of these methods the differences between adjacent forms were due in part to the rotation-expansion component and in part to "pure" form distortion. As each of these components might show a different relationship with the perceptual spacing, the results of the three experiments involve a confounding of these relationships. By placing additional restrictions on the choice of *dx* and *dy* increments added to the original points, it is possible to ensure that the rotation-expansion component will be zero. All differences between adjacent forms then would be due to "pure" form distortion. Similarly it is possible to suggest a variety of rules for drawing the outlines of the forms that would avoid the cross-over effects found in Figures 1 and 2. This would reduce some of the abrupt perceptual changes between adjacent forms such effects produce and thus possibly make for a closer relationship between the perceptual and objective spacing. One such rule would be the following. For each of the successive sets of points generated by adding the *dx* and *dy* increments to the initial form, radii would be drawn from each point to the center of gravity of that form. Then the outline would be drawn by connecting the points lying on adjacent radii. In all cases this would generate a single enclosed area without cross-overs. In addition this would ensure that the actual area of the form was directly related to the expansion component in the partitioning of the sum of squares, a result that does not obtain when there are cross-over effects. It should be emphasized, however, that all these rules concerning the drawing of outlines, the rotation of the point paths to generate the forms in the columns, and the restrictions placed on the selection of *dx* and *dy* increments are arbitrary. A more general formulation of Method II involving a different set of rules would permit innumerable matrices of forms to be generated from a given initial form, and some of these might show a much closer relationship between perceptual and objective spacing.

H. SUMMARY

The present study presents two methods for generating two-dimensional forms each of which yield an objective measure of the spacing of the forms. In the first method two forms are selected, the outline of each being represented by a set of points joined by straight lines. The initial form is then continuously distorted until it becomes the second. This distortion process can be represented by a set of paths along which the points of the first form move until they become the points of the second form. By taking fractional parts of each of these paths, sets of new points are determined which define

a form intermediate between the two original ones. By reiterating this procedure, any number of such intermediate forms can be generated. By rotating the paths 90° counterclockwise, a column of forms is generated that in an objective sense is at right angles to the row of intermediate forms previously generated. An extension of this technique permits the generation of an entire matrix of forms. The objective measure of spacing of the forms within this matrix is defined by the sum of the squared distances between the points in one form and the corresponding points in the adjacent form. The second method used in generating two-dimensional forms was a generalization of the first method. After the set of points defining the original form was determined, a dx and a dy increment were assigned randomly to each of these points. These increments defined the path along which the points of the first form moved in order to define the second form. By again adding these increments to the new form, a third form was defined and so on, until a row of forms was obtained. The paths defined by the increments were rotated 90° counterclockwise so as to generate columns of forms, thus producing an entire matrix. The same measure of objective spacing, the sum of the squared distances between corresponding points in adjacent forms, was used in this method.

To determine the relationship between the objective measure of spacing of these forms, i.e., the sum of the squared distances between adjacent forms, and the perceived spacing of them, three form recognition experiments were run. The first two were based on forms generated by the first method and the third on forms generated by the second. In each the *S* was shown a row or column of a matrix of forms, called Identifiers (*Id*), and then shown in random order a series of forms from the matrix, called stimulus forms, for two seconds each. After each such exposure of a stimulus form, *S* judged which of the *Id* forms it most closely resembled. The assumption made in the analysis of the results was that the more closely a stimulus form perceptually resembled a given *Id* form the less variability there would be in these judgments from one *S* to the next. Consequently a plot of this variability against a measure of the objective distance between the stimulus form and its corresponding form among the *Id* should indicate if any simple relationship existed between the perceptual and objective spacing of these forms. The major conclusions were as follows:

1. Both methods of generating two-dimensional forms provide a complete and simple summary of the specific set of forms involved in form recognition studies. By listing two sets of numbers, i.e., the coördinates defining the set of points in the original form and the dx and dy increments added

to each of these points, along with the rule for drawing the outlines of the forms, it is possible to duplicate exactly any given set of forms.

2. The perceptual ordering of these forms within a row or column of the matrix is on the average exactly the same as the order in which the forms are generated. If the objective distance, as measured by the sum of squared distances between corresponding points, is greater between Forms *A* and *C* than between Forms *A* and *B*, then *B* is perceived as more similar to *A* than is *C*.

3. There is no simple relationship between the absolute size of the measure of objective spacing and the perceived spacing of the forms. The relationship found depends upon the specific set of forms used. In Experiment 1 the matrix of forms was constructed so that there would be the same objective spacing between rows as between columns. Nonetheless two distinct functions were obtained relating variability in judgment to the objective distance between stimulus form and *Id*, one when the rows of the matrix were used as *Id* and a second when columns were used. In Experiment 3 a single large matrix of forms was divided into three sub-matrices. Each of these three sub-matrices yielded a different function relating variability in judgment to the objective difference between stimulus form and *Id* even though the latter was a constant for each of the three sections of the original matrix.

4. Even though the relationship between perceived and objective spacing is specific to each set of forms generated by either of these methods, this relationship is relatively stable as shown by the fact that in Experiment 2 the results of Experiment 1 were duplicated on a relatively small sample of *S*s. In addition, Experiment 2 indicated that the general form of the relationship was independent of whether or not the *Id* forms were presented in standard or random order although in the latter condition the absolute size of the measure of variability in judgment increased.

5. A number of suggestions are made for changes in the process of generating forms which might produce a more constant relationship between the perceived and the objective spacing of forms.

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LETHAL INTERACTION OF CHLORPROMAZINE AND ELECTROCONVULSIVE SHOCK*

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Electroconvulsive shock has enjoyed wide-spread usage during recent years as a therapeutic instrument for the treatment of patients suffering from mental and emotional disturbances. Still more recently, the so-called "tranquilizing" drugs have been applied in control of certain behavior aberrations (1, 2, 3, 4). The more prominent of these drugs, reserpine and chlorpromazine, while having value in the clinical situation, not infrequently produce unfortunate side effects such as jaundice and anorexia (4).

The purpose of the present study is to call attention to another deleterious effect, viz., a synergistic relationship between the administration of chlorpromazine and electroconvulsive shock which increases the probability of death in the albino rat.

Sixty female rats of the Sprague-Dawley strain, randomly divided into three groups, served as subjects in this experiment. At the beginning of the experimental procedure, all were normal animals approximately 120 days of age. The three groups of animals corresponded to the three treatment conditions of the experiment. Each subject of Group I (high dose) received an intramuscular injection of chlorpromazine in the amount of .006 mg/gm of body weight on the first, third, fifth, and the seventh day of the experiment; Group II (low dose) was given .002 mg/gm of body weight on the same days; Group III (control) was administered a placebo.

On each day of drug treatment, three hours after injection, each of the subjects was given electroconvulsive shock. Electrodes were placed on the ears of the animals and 36 stimulations with alternating current (60-cycle, 1,800 volts, 175 milliamps) were made. Each electrical impulse was of 0.2-second duration separated by a latency of 1.8 seconds.

The results of this experiment are shown in Table 1. The differences

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TABLE 1

SURVIVAL RATES OF 60 ALBINO RATS SUBJECTED TO ELECTROCONVULSIVE SHOCK* UNDER THREE TREATMENT CONDITIONS

Group	Number	Died	Lived
I—High Dose (chlorpromazine: 0.006 mg/gm body weight)	20	14	6
II—Low Dose (chlorpromazine: 0.002 mg/gm body weight)	20	8	12
III—Control (placebo)	20	2	18
Total	60	24	36

*Administered in 0.2-second impulses separated by a 1.8-second latency period.

between the mortality rates for the three groups is significant at the .01 per cent level using a Chi square analysis of the data. It appears from a consideration of these data that the simultaneous use of chlorpromazine and electroconvulsive shock therapy may not be in the best interest of the patient's welfare.

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THE YOUNG EAST GERMAN AND SOVIET DEFECTOR: A REPORT ON SIMILARITIES*

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A. INTRODUCTION

One of the surprises in store for the Western social scientist who is accustomed to standard "correlated differences" of one kind or other and who will go to great lengths to "find" them is the extent to which the sovietization[2] of diverse peoples not only suppresses or renders irrelevant many of these differences, but also introduces in their stead a certain sameness of outlook and reaction that is astonishing in view of the traditional disparities of people representative of different classes and cultures.[3] Recently van Broekhuizen (5-8), basing himself on a continuing study of the East German defector to the West, described the characteristics of the East German youth. Had he substituted "Soviet" for "East German," he could almost be said to have described the characteristics of the Soviet youth as represented in the emigration by the recent defector. This is so striking as to invite an analysis of the similarities exhibited by the young defector from East Germany, as reported by van Broekhuizen, and the Russian counterpart from the Soviet Union. Information on the latter will be drawn from the research of the Inwood Project on Intercultural Communication conducted over the last three years.[4]

B. THE POLITICAL NATURE OF THE DEFECTOR'S REACTION TO THE WEST

Van Broekhuizen indicates that the attitudes of the young East German defector to the West, to its way of life, and to its problems are much more

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[1] The writer acknowledges the preliminary assistance of Oleg Anisimov and of Miriam B. London (Inwood Institute). The study reported was undertaken by the Inwood Project on Intercultural Communication with the support of the Inwood Institute and the Dearborn Foundation.

[2] The term *sovietization* will refer to the process of rendering a society in a given country after the pattern obtaining in the Soviet Union.

[3] This sameness has been noted also by Sheldon and Dutkowski (4) in considering whether data, based on interviews with refugees from Eastern Europe, were projectable in spite of the nonrepresentative character of their sample in terms of generally employed socio-economic criteria.

[4] For an indication of the scope and methods of the Inwood Project, see References 1-3.

strongly colored by political notions than is customary for young people who have grown up under Western conditions. This applies also to the non-ideological defectors, that is to say, to those East German youths who defected to the West primarily for personal reasons: the desire to avoid induction into the "people's police," the impossibility of continuing one's education or finding a suitable job, etc. The politicized approach to matters which are commonly regarded in Western countries as nonpolitical is, as a matter of fact, quite thoroughgoing and is typical also of the attitudes displayed towards the Western world by most Soviet defectors.

In this connection, one should note that the term "politics" has a much broader meaning for the man in a sovietized society than it has for a citizen of a democratic country. The Russian language, itself, enlarges its meaning by obscuring the distinction between "politics" and "policies," the term *politika* being used to denote both. Accordingly, under a sovietized regime important areas of activities, regarded as "private affairs" in the West, come to be shot through with "politika." For example, since social origin and political reliability have in a sovietized country an important bearing on a man's ability to get a suitable job or to continue his education, much for him depends on what is the government's *politika* in matters of education and employment. By contrast, the citizen of a free democratic country does not, as a rule, associate his ability to get a college degree or a suitable job in private life with "politics."

C. Relative Unimportance of Social Status

Differences in the social status of young East German defectors do not appear to be reflected in correlated differences in their general political outlook or in their attitude towards the Western world and its way of life. In other words, social differentiation appears to be a far less important factor in shaping the *Weltanschauung* of the East German youth than the leveling influence of communist indoctrination and the uniformities of a sovietized way of life.

For example, by always emphasizing big issues and fundamental problems, by making all questions relate to common objectives, Soviet propaganda, which is incessant and everywhere, tends to cancel many socially differentiated ways of viewing things or to dissolve them in the sloganized bigger issues which affect all men: durable peace versus annihilation in atomic war, international brotherhood of nations versus national rivalries, atoms for production versus atoms for destruction, etc. Thus, the influence of social differentiation is minimized and a sense of community, that is to say, of all being in the same boat, maximized—factors leading to an over-all sameness of outlook.

In the case of the Soviet defector, life-long exposure to the same propaganda and the Soviet way of life appears also to be a more potent factor in evolving a "Soviet" outlook, reflected in his attitude to the West after defection, than individual standing in the social hierarchy. Like most young East Germans who escape to the West, it is found, for example, that Soviet defectors, regardless of social status and origin, everywhere tend to single out for criticism the *same* features of the Western way of life and of democratic political practice.

D. Acceptance of Soviet Criteria

Van Broekhuizen indicates that even after his defection the young East German refugee continues to judge the West by the criteria taken over in the course of growing up in a sovietized society. This is also true of most Soviet defectors. Paradoxically, the continued acceptance of Soviet criteria may be seen also in the tendency of the latter to denounce the Soviet regime, not for the unworkability of its professed ideals, but *for its failure to live up to them.*

Van Broekhuizen finds, for example, that, while rejecting the political system instituted in his country as a fraud, the young East German defector continues to adhere to the Soviet view that (*a*) the function of political ideology is to offer precise "answers" to basic questions about man: his place within society and the state, and that (*b*) the function of "politics" is to evolve consistent, well-coördinated strategies for the translation of these "answers" into reality. Since the West is committed to neither view, for the young East German defector it fails on both counts.

The same need for "answers" and their translation into practice is also characteristic of most Soviet defectors. Again, since the West satisfies neither, this is viewed as a grave defect.

E. Reevaluation of Communist Theory and Practice

Approval by the young defector from East Germany of certain features of his country's regime is usually unconscious in the sense that these features are taken for granted. Only the *absence* of these features from the Western way of life makes many a defector realize what he has lost: familiar surroundings, the privileged position enjoyed by youth and the chances of rapid advancement, economic security, etc. Interestingly enough, this leads the young defector to reevaluate communist totalitarianism and the Western way of life not so much in the light of what he *finds* in the West, but primarily in the light of what he *misses* there.

Reevaluation of the Soviet regime and the Western world, in the light of what they miss rather than in the light of what they find there, is characteristic also of many Soviet defectors, who expect the noncommunist world to be free of all the defects of the Soviet regime, while possessing all those features of the totalitarian system which are felt as good: economic security, adherence to a purposeful and realistic long-range policy, a "big" approach to politics and economics, free medical treatment, etc.

This does not mean that the Soviet defector ends up by concluding that the Soviet regime is better than western democracy. The percentage of Soviet refugees who "redefect" to the Soviet Union is not high in spite of the Soviet campaign for redefection—much lower than the 20 per cent given by van Broekhuizen for the East German youth. Yet it does mean that more often than not the Soviet defector winds up in complete disillusionment with *all* political systems.

F. THE TENDENCY TO VOLUNTARY AND INVOLUNTARY DISSIMULATION

Van Broekhuizen cautions against taking at face value what a young East German defector says to those who interview him, since according to van Broekhuizen the defector tends to speak what he thinks one would expect him to say, not what he really thinks. This tendency, which the young East German defector shares with most Soviet defectors, may be traced in part to the fact that one who has grown up under sovietized conditions tends to regard everybody in a "special" position as an "official," who may in large and small ways affect one's life, and to attach, therefore, greater importance to personal connections than is customary in the West. The interviewer occupies precisely such a "special" position.

In the case of the Soviet defector, there is the additional fact that the application of U. S. immigration laws to Soviet refugees in Western Europe involves the exercise of discretionary powers on the part of the administering officials. Soviet defectors who wish to emigrate to the United States are thus often motivated to establish a "democratic" reputation for themselves and to live up to a fictitious type.

A subtler reason, sharing with that previously suggested, for not accepting the defector's words at face value lies in the defector's sense of the hopelessness of communication—backgrounds and experiences are too different. In other words, what happens is that the defector does not really say what he thinks the interviewer wants to hear, but rather says what he thinks the interviewer can *understand*. Obviously the latter alternative does not lead to an objective account of self or even things.[5]

G. Manifestation of Inferiority Feelings

After their escape to the West many East German youths are seen to develop feelings of inferiority. To understand this, one must remember that sovietized regimes boost, cater to, and glorify the youth. Thus, to cite an extreme case, in East Germany it is quite possible for an 18-year-old to become the mayor of a small town, but not in the West where he is looked upon as an immature boy and where swift mobility upward is denied him. The real but impalpable constrictions, confronting the young East German defector in the West, baffle him and serve to develop feelings of inadequacy and inferiority, especially where the young defector is experiencing difficulties in the unaccustomed and unpracticed art of fending for himself both economically and in other ways.

The Soviet defector likewise is a frequent manifester of inferiority feelings, so much so, that there has been a too ready tendency to ascribe an "inferiority complex" as a national trait to the Russians vis-à-vis the West. This is a glib and questionable extrapolation from *some* Soviet emigres to *the* Soviet citizen. A sense of inferiority in the Soviet defector, when it does appear, is probably less a manifestation of a deep national trait than a function of *personal contact* with an unfamiliar and more sophisticated West as well as of the disappointing aspects of life in the emigration.[6]

By way of tentative conclusion, based on the suggestive similarities that have been noted between the young East German and Soviet defector, we may state the following:

1. The pressures which make for uniformity in many areas of life have a more powerful effect on *any* population exposed to a lengthy experience

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[5] The research of the Inwood Project suggests that this sense of noncommunicability is a factor of great importance, reducing sharply the value of research material procured under procedures not taking this matter sufficiently into account (2).

[6] Foreigners who have observed Soviet citizens at home in the USSR have on occasion reported behavior and conversation which they represent as evidence of a widespread inferiority complex. These foreigners profess to note a defensive superiority, aggressively asserted, in the Soviet citizen and, considering this the obverse sign of inferiority, have concluded that he is, in fact, ridden with feelings of inferiority. The superiority noted may easily be a misconstrued aspect of human encounters between individuals of different cultures and experience and may, hence, be an innocent construction of the reporting foreigner. Americans similarly have often had attributed to them as a people feelings of inferiority vis-à-vis the cultured European.

under sovietized conditions than do the factors which in other societies make for pronounced differentiation.[7]

2. Owing to the excessive politicizing of everyday life under conditions of communist totalitarianism, in analyzing the attitudes and reactivities of people living under sovietized conditions it might be more illuminating to apply political analysis rather than the standard social scientific analysis customary to research dealing with weakly politicized peoples. For example, however important one may think social and economic factors are in determining a Soviet defector's attitude to the democratic way of life, dissatisfaction with what he regards as the political weakness of the Western democracies in their struggle against communism is in many cases the decisive factor in the defector's ultimate opinion about, and attitude toward, the Western way of life.

3. In addition to articulate political concepts, people living under sovietized conditions possess a number of political notions of whose existence they are only vaguely, if at all, aware. The existence of this "inarticulate" political awareness is revealed to the sovietized citizen himself only when a complete change of conditions, as in defection, makes him *miss* those features of the sovietized way of life, which he had accepted without his being aware of it.[8]

4. In order to get an adequate idea of the political psychology of the citizen of a sovietized country, it is necessary to take into account not only his individual political notions, but their whole quasi-logical interdependence, since indoctrination with communism and the experience of a sovietized way of life foster a tendency to view "politics" as a comprehensive, integrated matter.

5. In analyzing the political notions and attitudes of people in sovietized countries, it is, in view of the preceding discussion, necessary on occasion to apply correctives to the data obtained from defectors. Furthermore, the suppression of freedom in a sovietized country frequently leads to the future defector's entertaining unrealistic ideas about the meaning, scope, and practice of freedom in the diverse enterprises of life in the West. It is not surprising, therefore, that very often when he comes to the West, which an

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[7] There is considerable evidence that the increasing social differentiation, which has appeared within the Soviet society in the last 15 years, is not reflected in a correlated differentiation in the political outlook of Soviet people, belonging to different social classes, to anything like the extent to which social differences presumably affected the political outlook of Russian people in prerevolutionary Russia.

[8] Even after he has crossed over to the West, a defector may be reluctant to admit to others, sometimes even to himself, that he may approve of certain features of the sovietized way of life left behind.

opponent of communism behind the Iron Curtain is apt to regard as a place where "you can do what you want," the defector feels a disappointment with and even a kind of revulsion against the Western way of life; he finds there neither that abstract, absolute freedom for which he was looking, nor that impressive show of power, order, and coherence, which he has come to accept as an integral part of the social order—on the condition, of course, that they be used for "good" ends. His attitude to the West is, accordingly, often illogical, contradictory, and moved by strong and opposite emotions.

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AUDIOGENIC SEIZURES AND THE A/JAX MOUSE*

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A. Introduction and Problem

In a previous paper (9) the writer showed that the inbred mouse strain, DBA/2, was very susceptible to a certain auditory stress, the sound of the ringing of a doorbell at approximately 92±2 decibels. Each animal was *exposed only once* to the sound. An immediate and violent fatal convulsive seizure of the clonic-tonic pattern resulted. This reaction or audiogenic seizure was at its height at ages between 28 and 35 days.

This susceptibility to sound-induced convulsive-seizures was tested at different age levels, in over 5,000 individuals. At each age a new group of animals was introduced. The reactions at the different ages were all *first exposures* to the sound stimulus. Between 20 and 29 days the incidence of convulsions was 82 per cent; 69 per cent of the convulsers died. Between the ages of 28 and 35 days the convulsion incidence was 90 to 95 per cent; with 80 to 85 per cent of fatal seizures. At ages 60 to 69 days 25 per cent of individuals convulsed and somewhat less than half of the convulsers died. At ages 70 to 79 days 17 per cent convulsed and little more than 50 per cent died. The incidence is thus seen to gradually decrease at higher age levels. No convulsions occurred in animals over 90 days of age.

An attempt was made to discover the distribution of audiogenic seizure susceptibility among the various strains of mice, *Mus musculus*. Pilot experiments on several distinct inbred strains were made, such as CE, A, C3H, C57BL/6, C57BL/10, C57BR/cd, DBA/1, Bagg-albino, 129, N(S/vi), and Swiss-albino. Some of these have been reported in brief (10, 11). Although some strains followed the DBA/2 audiogenic seizure behavior pattern others showed differences and variations. One of the strains which yielded a distinctly different behavioral pattern from the DBA/2's was an inbred albino strain, the A/jax strain. Further experiments on a larger scale were then carried out for the purpose of defining the incidence and nature of the syndrome in this strain.

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B. PROCEDURES

The identical apparatus and auditory stimulus were used for the A/jax strain as were applied to the DBA/2 strain. Also the same environment, food, housing conditions, and handling procedures were used. All factors were uniform and identical for each animal tested. The only variable factor was the *age* of the mouse. Different animals were tested at age intervals of five days from 20 to 435 days. Each animal was exposed only once to the stress, or sound stimulus. Over 900 individuals were tested, with about equal numbers of males and females and the animals were not mated at any time during the experiment. The animals used in this report were from the author's own colony (A/jax, vi) which was started in year 1942 with two pairs from Cloudman's A/jax stock.

C. OBSERVATIONS AND RESULTS

1. *Descriptive Account of Strain Behavior*

Before turning to experimental results, the behavioral response patterns of the two strains under ordinary laboratory handling are compared. The DBA/2 mouse is very active, jumpy, excited by normal environmental changes; the A/jax mouse is less affected by the same changes. The A/jax mouse, whether male or female, is a sluggish, calm individual.

2. *Age and Seizure Incidence*

In these extensive studies a 10 to 15 per cent incidence of susceptibility at ages between 20 and 40 days was found. [The earlier smaller sample (10) showed around a 2 per cent incidence.] The incidence of convulsion increased from 20 to 35 per cent between 45 and 85 days and decreased to 5 to 20 per cent between ages 85 and 305 days. However, these seizures were not the typical DBA/2 clonic-tonic type but rather an incomplete non-lethal convulsion of the clonic form.

3. *The Patterns of Responses*

The typical reaction of the A/jax mouse to the sound-stimulus is primarily a freeze and not a clonic-tonic convulsion. In only 5 to 30 per cent of individuals is this reaction preceded by a clonic form of a convulsion. The *outstanding feature* of the A/jax response, especially at the older age levels, is the sudden suspension of muscular movement, expressed by various degrees of standing spasms and tremors with variations in freeze postures. These often include head movements from side to side or up and down, closure of the eyes with ears pinned back, face twitching and rhythmic tremors of the body. These reactions occur in over 80 per cent of the individuals throughout the age levels from 45 to 325 days. The severest catatonic-like freezes occur between the ages of 85 to 250 days. The remaining individuals have milder reactions and they are spread also over the same wide age distribution.

In addition to its typical catatonic-like freeze, a low proportion of individuals exhibit a partial convulsive seizure, simulating the clonic phase of the DBA/2 convulsion. The peak incidence of this partial convulsive reaction is only 25 to 35 per cent and occurs in the class age of around 70 to 90 days. From 100 to 250 days of age the per cent incidence of susceptibility to this convulsive pattern is 5 to 20 per cent. From 250 to 305 days the incidence is around 2 to 4 per cent and from 305 to 430 days it is lower than 1 per cent.

The individuals undergoing convulsive-like seizures often show before or after the convulsions the usual freeze reaction, but in a milder form. Sometimes they exhibit the frantic running type behavior. All these convulsive seizures, however, even at the peak of susceptibility are never as severe as those of the DBA/2 strain. They are of shorter duration and never end in death as is usual for the DBA/2 strain.

4. *Comparison With DBA/2 Strain*

A comparison of the two strains with respect to incidence of audiogenic (epileptic-like) seizures is shown in Figure 1. The per cent frequency is plotted against the age classes. There is a striking difference in the two curves. The DBA/2 curve shows the highest incidence of the clonic-tonic convulsive seizures at ages 28 to 35 days. Only 10 per cent of A/jax individuals at this early age exhibit a susceptibility for the clonic phase of convulsion.

The A/jax strain susceptibility curve shows a 15 per cent incidence at class age 45 days. The per cent frequency rises slightly with age and reaches its maximum at class age of 85 days. Even here the incidence is only 35 per cent. Moreover, seizures of the A/jax are usually incomplete and less severe. The DBA/2 at age 45 days is still close to its peak performance, with over 85 per cent incidence and then the curve suddenly drops to 15 per cent at class age of 85 days. At 100 days and older age levels, the DBA/2 strain never convulses. On the other hand, though of a milder form the A/jax strain sustains its sensitivity to the convulsive pattern over an older age level, or 100 to 305 days. However, this is expressed in only 2 to 10 per cent.

The characteristic reactions of the two strains in response to the sound stimulus are distinctly different. The DBA/2's reaction is characterized by extreme activity ending in epileptic or audiogenic seizures; the A/jax's reaction is characterized by immobility and a form of catatonic seizure or spasm. The age susceptibility distribution is narrow, 20 to 85 days, for the DBA/2 and wide, 30 to 325 days, for the A/jax-vi. The maximum effect is between 28 and 35 days for the DBA/2 (lethal convulsion) and between 90 and 250 days for the A/jax (catatonic freeze). The incidence of seizure susceptibility is 90 to 95 per cent for the DBA/2 and 80 to 85 per cent for the freeze type of the A/jax strain. In addition, the *latency* or the period between the stimulus and the response, is 5 to 20 seconds for the DBA/2 and 20 to 60 seconds for the A/jax strain. The duration of the audiogenic seizure of the DBA/2 is 5 to 15 seconds and for the catatonic freeze seizure of the A/jax is 120 to 1,800 seconds.

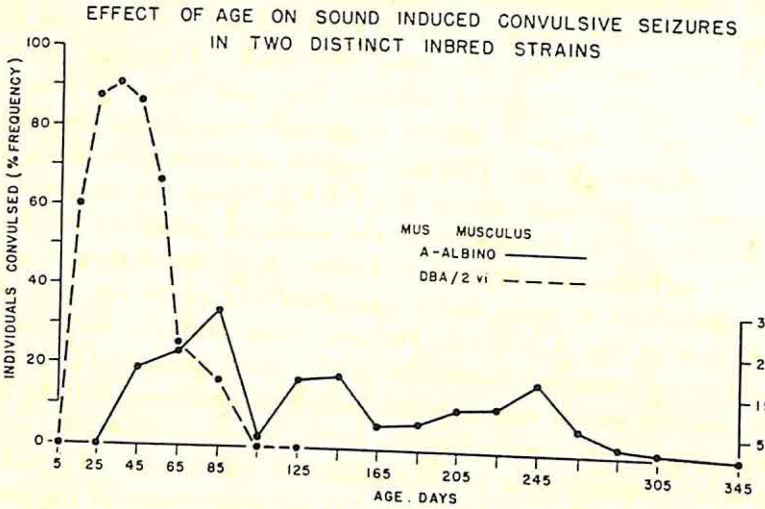

FIGURE 1
A Comparison of Strain A/jax With Strain DBA/2 With Relation to Their Per Cent Frequency of Audioepileptic Seizures at Various Ages

D. Discussion

The observations in these studies reveal that the A/jax strain behaves differently from the DBA/2 strain in its reactions to the same sound or auditory stimulus; that these reactions though markedly influenced by age in the DBA/2 are not so influenced in the A/jax strain. Frings tested some DBA/1 mice (3). In spite of the variations in his testing procedure and apparatus he found that at a frequency of 10kc/sec at 110 db sound pressure, which is close to our audiogenic stimulus, there was a drop in seizure susceptibility in his older mice. This is in accord with those of DBA/2. Working with rats Maier (7) found that susceptibility to seizures during auditory stimulation increased rather rapidly with age until it reached a maximum which occurred at about 20 weeks of age. At 12 and 40 weeks the degree of susceptibility was about the same. This peak incidence in adult ages resembles the A/jax results. Dice and Barto (2) have found that the genus, Peromyscus, showed a decrease in auditory sensitivity with age at the ultrasonic level. This may suggest an explanation in the decrease seizure susceptibility with age in the DBA/2 strain but does not suggest an explanation or a clarification of the sustained sensitivity of the A/jax strain. In an inheritance experiment Fuller (4, 5) found that at ages 30 to 34 days his albino *A* strain had a convulsive risk of 11 per cent which is close to that of the A/jax, vi. He also found that the incidence can be increased by agitation and cumulative trials. Some studies (12, 13), aiming at the causes of seizure susceptibility, have been made and will be discussed in a later paper. For a general review of the literature the reader is referred to Bevan's compilation on sound-precipitated convulsions (1) and to the works of Fuller (4, 5) and Ginsburg (6) for a treatment of the genetics of the problem.

E. SUMMARY

The A/jax inbred mouse strain has been subjected to the same auditory stimulus as was given to the DBA/2 inbred strain and its response is markedly different. This difference is noted chiefly in the type of abnormal behavioral seizures and in its age-level of susceptibility. The DBA/2 strain responds with epileptic-like seizures, the A/jax with catatonic-like freeze seizures and sometimes especially in the earlier ages is accompanied with mild clonic convulsions. The age thresholds differ; that of the DBA/2 is narrow, that of the A/jax is very wide. The audiogenic seizure age of susceptibility in the DBA/2 is highest at the adolescent age while the A/jax strain sustains its susceptibility to catatonic freeze seizures throughout its adult age.

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CONTRIBUTIONS TO A LEARNING THEORY ACCOUNT OF CHILDHOOD AUTISM*

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A. INTRODUCTION

Although learning theory formulations have been applied to a variety of problems in psychopathology and psychotherapy (1, 2, 11, 12, 14), little systematic theoretical attention has been given the specific problem of childhood autism. In the comprehensive collation of the literature recently published by Goldfarb and Dorsen (6), only one article seems to go directly to the point of relating autism to learning theory (5). In this paper attempts are made to go more systematically into this problem, and to relate some neglected aspects of autism, in the form of socio-cultural data, to the theory.

B. PROBLEM

The problems examined here are: (*a*) revealing the nature and extent of theory and research on autism; (*b*) the meaning of some limited socio-cultural data for the theory proposed; and (*c*) offering some ideas related to a brief systematic account of autism based on learning theory-conflict theory principles.

C. METHOD

Two methods are involved in the data reported upon: (*a*) a categorizing of publications (6) into predominantly theoretical, clinical, research, review, and description-of-a-program groups; and (*b*) the presentation of ordinal position and sex data on autistic children in comparison to normal children and less disturbed children (13).

D. RESULTS

Publications collated by Goldfarb and Dorsen (6) were categorized as stated above and also in terms of dates of publication (before 1900, and by decades since 1900). The following breakdown results (Table 1).

Arguments can be offered as to the reliability of the categories, since many theoretical articles are also clinical, and vice versa. Some of the

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literature reviews are seen in a context of clinical and/or theoretical discussions. The separate columns show a gradual increase, by decades, toward more articles in each category, with the theoretical and clinical articles leading in both relative and absolute numbers. Over 60 per cent of the publications through 1954 were theoretical-clinical, with classification of symptoms, the developing of diagnostic categories, and the theorizing about the causes of autism predominant. No systematic personality theory, other than fragments of psychoanalytic theory, was involved in these explanations.

TABLE 1

Dates	Theoretical	Clinical	Research	Review	Description
——-1900	02.4%	03.4%	00.0%	00.7%	00.0%
1900-1909	01.3	01.2	00.0	00.0	00.0
1910-1919	01.3	01.7	00.3	00.0	00.0
1920-1929	01.5	01.0	01.7	00.2	00.7
1930-1939	03.4	04.3	05.3	01.0	00.3
1940-1949	05.6	09.3	10.1	02.0	03.6
1950-1954	10.1	13.7	08.6	01.2	04.0

In the research category (26 per cent of the total publications) less than one-half were psychometric-behavioral or concerned with therapy or follow-up; in the latter sub-group few studies utilized independent, objective instruments for determining progress or status. About one-third of the research articles were physiological (drugs, shock therapy, endocrinological), and less than a fourth were related to socio-cultural variables (family background, incidence rates, classification of types). Research, then, seems to play a minor rôle in forming the present set of attitudes toward childhood autism; little of the research is socio-cultural, and virtually none of the theory of autism is related to extant developments in general psychological theory.

The second group of data is contrasted with the above publication summary in emphasizing socio-cultural factors (13) and in stimulating the theoretical basis for a conflict-centered learning theory account of autism (12).

Among 27 cases of childhood autism known by the writer, 23 (85.2 per cent) were boys. This ratio is extremely biased, compared to the 50-50 ratio expected from the general population distribution ($CR = 5.22$; $p > .001$). Thus some enormous bias is introduced either by virtue of biological or socio-cultural factors. The existing literature, especially among the physiologically centered studies, admits of no *differential* condition affecting males over females. This observation will be referred to again below.

A second comparison of autistic children with lesser disturbed children and with children in general exists via ordinal position (13). In the general population the rate of first born (including only children) is 44.12 per cent (13, 15). In a population of 635 disturbed children referred for psychological help (non-autistic), 76.38 per cent were first born (including only children). This proportion, in comparison to the distribution of first born in the general population (about 44 per cent), netted a difference reliable well beyond the .001 level. In the data on autism, 12 out of 15 in one population and 10 out of 12 in another, were first born, giving a figure of 81.5 per cent. This figure, compared to expectations from the general population, yields a critical ratio reliable well beyond the .001 level ($CR = 5.23$).

Some confidence, then, can be placed in the statement that autistic children deviate from the normal in matters relating to sex and ordinal position in the same way lesser disturbed children do; and that in this regard the differences between autistic and lesser disturbed children appear to be continuous and quantitative.

E. DISCUSSION

Since learning centered discussions of autism have been almost totally missing from the literature, and since existing data have not pointed very clearly to the presence of physiological factors that would differentiate between sexes and between the first and latter born, the emphasis here is placed on a brief learning theory account of autism.

Deriving the theory from Miller's approach-avoidance conflict (10), let us grant the following assumptions:

A. The approach gradient is equated with *Assertiveness*. An assertion is the belief in any proposition, or the tendency to act in a particular way under a given set of circumstances.

B. The avoidance gradient is equated with *Disconfirmation*. A disconfirmation is any environmental, interpersonal, or subjective hindrance to the confirmation of an assertion, or any failure of the assertion to be confirmed at expected levels.

Conflict exists between *A* and *B* as a function of the relative and absolute strengths of the assertion and the disconfirmation. Conflict exists to a minor degree in nearly all the organism's activities; it is usually severe and/or persistent conflict that is accorded the status of psychopathology.

C. Conflict creates tension and this gives rise to symptoms. Symptoms are signs of tension derived from conflict. The "choice of symptoms" is presumably determined by the nature of the conflict and by the environmental possibilities for coping with the conflict perceived by the organism.

D. Redundancy ensues if the conflict is not resolved; that is, if the assertion is not confirmed (or if the disconfirmation is not avoided). The redundancy (repetitiveness) is extensive if the assertion-disconfirmation dimensions are strong. The organism that does not give up but fights it out over and over against overwhelming odds is redundant.

A proposition follows: The stronger the assertion, the less the amount of information necessary to confirm it and the greater the amount of information necessary to disconfirm it. A corollary: The greater the assertiveness the less the information needed to threaten (but not change) it.

The theoretical emphasis on assertion-disconfirmation conflict requires specifying what it is that the autistic child asserts. Evidences of the autistic child's assertiveness are seen in his opinionation, his willful, demanding, and unilateral attitudes in his relationships with others. He asserts his demands more strongly than do children in general, which places him in more persistent and pervasive conflicts with others. The stronger he asserts the more difficult it is to get to him the necessary information for change in his behavior; but in a corollary sense, the stronger his assertion the more vulnerable or easily threatened it is. Hence his temper and his withdrawn position are evidences of pressures brought on others to yield to his demands and/or hurt feelings-guilt-suffering-pity at not being confirmed in his expectations. How does the autistic child become this way?

As we have seen, disturbed children referred for psychological help are more often boys and first-born. These facts seem to mirror a socio-cultural, parent-child relationship believed to be common in our society. Parents are not psychologically well prepared for the first-born; they are too "nervous" about the child's development, too fearful lest he not do well. Boys get a larger share of this concern since they are supposed to be aggressive and outgoing. It is easier to stop or limit girls in their assertiveness since their rôles are more clearly defined. How much is "too much assertiveness" for boys? The cultural prescriptions, the parents' uncertainties, the organism's tendency to increase its orbit of assertiveness with development all combine to blur the picture needed by parents for effective control.

These uncertainties in the *parent*-child relationship give rise to an opinionated position on the part of the child ("If my parents don't know or can't decide, *then I will*"); to an unsureness on the part of the child (parents and outsiders treat him differently, giving rise to authority conflicts); and to an unwillingness to take on normal responsibilities ("Why should I—my parents do it for me?"; and "I'm special and don't have to act or be like others, anyhow"), and to a retreat into themselves when the accumulated fatigue and discouragement from these attitudes become overwhelming. Thus the intention to preserve sameness in their environment so strikingly observed by many clinicians (8), and the loss of contact with others. They are maintaining a resolute but nonetheless losing battle with the environment over whether their method of interaction will predominate.

Some deductions follow from the above strictures. The autistic child's difficulty exists not in sensation (3) but in the persistence of their expectations (assertions) vis a vis the environment. They assert strongly and yield little. This gives rise to the perseverations (redundancies) noted and to their relative imperviousness to "outside" stimulation. This makes alternative ways of behaving and amenability to change weak.

The autistic child's difficulties are not biologically determined; they are not primarily maturational (4). Rather, the autistic process cannot develop, it is hypothesized, until the child is old enough to have developed the capacity to deal with abstractions, expectations. The burden of proof rests on those who assert that the autistic process generates in bio-maturational or "dysmaturational" conditions, involves their delineating differential criteria between "autistic maturation" and "non-autistic maturation" and the specification of the conditions under which the alleged biological dysfunction occurs. Evidence supportive of the present viewpoint comes from the observation of near-normal behavior the autistic child shows on occasion. The situation here is not unlike the differences often noted between pseudo- and primary feeblemindedness; only with rare exception does one find high peaks or "sparks of intelligence" among the primary feebleminded. Whereas among pseudo-feebleminded these psychometric sparks are noticeable, and this observation can often serve as a differential criterion between pseudo- and basic feeblemindedness. In a like manner, the truly damaged child neurophysiologically (e.g., some cerebral palsy cases) fails to show the occasional normalcy that the autistic child shows. This is interpreted as an example of the *selective* nature of autistic functioning (in specific momentary ways associated with current assertion-disconfirmation conflict), and means also that they are not autistic all the time or in all respects.

A third derivation from the theory outlined briefly above consists in asserting that the difficulty with autistic children (etiologically and existentially) is not that they suffer from a kind of deficiency motivation (7, 9) but from an "excess motivation." This refers to the extent, to the stringency, unilaterality of the assertions (and consequent vulnerability and lack of confirmability associated therewith), and to the redundancy that follows. One cannot fail or be inadequate or unworthy if he has no scale of expectations to go by, to use as a reference base.

This derivation has enormous implications for psychotherapy and management of the autistic child. The problems become those of handling the child's assertions more directly, more modestly, and more consistently, in not allowing him to demand and get away with it. To the extent that these corrections are successful the child's adjustment improves because he is not then operating against such overwhelming odds; he can gain more modest success in life and feel relief therefrom. Psychotherapy in the usual sense of the term is largely inoperable with these children; the first emphasis and correction, it is maintained here, has to come from environmental and interpersonal control of the child's assertions.

A fourth implication of the learning theory position taken here is that background factors, in the sense of severe disturbances or schizophrenia in the immediate family, is not an *exhaustive* or *primary* causal condition. In the group of 15 autistic children alluded to above, only two homes were broken, and no immediate family members were disturbed to the point where outside help was needed. All sibs of this group of 15 autistic children were normal and none of them who were of school age had come to the attention of school personnel for any emotional, disciplinary, or psychogenic reasons. While family background may be a *sufficient* condition for disturbances in a significant per cent of cases of autism (and other psychogenic conditions, too), it is not a *necessary* condition; there are sufficient conditions other than the home for producing severe disturbance. The potentialities for producing neurotic conditions in humans and the actual demonstrations of same in animals, the recent data on "brainwashing" in experimental studies, seem to attest to the fact that the proper manipulation of crucial variables in the organism's environment is of utmost importance. Family background is *an example* of how such variables may be unwholesomely manipulated; it is not an exhaustive, causal, theoretically complete explanation. Thus it is only adding to the vagueness of our understanding of autism to insist that it is the "family background" which is responsible. The issue in a scientific sense revolves around the specific conditions that give rise to any psychological disturbance (in the family, in experimental conditions, in the culture at large). In the present theory it has been suggested that the conflict between assertions and disconfirmations is the nuclear condition responsible for the autistic disturbance. This is an abstract theory and can be presumably held to account for the presence or absence of crucial conditions in the home, in experiments, etc., that give rise to autism.

F. SUMMARY

Data in the form of a review of articles appearing on childhood autism have been assembled and classified as to type (theoretical, clinical, research, review of literature, and discussion of program). It was shown that theoretical-clinical articles predominate, and that the research articles were largely physiological and psychometric-rating types. Theoretical discussions referred very infrequently to a learning theory type of explanation.

A second group of data on 27 autistic children was presented and compared with a group of 635 non-autistic, disturbed children and with children from the general population as to sex distribution and ordinal position. It was shown that the autistic group, like the non-autistic, disturbed group was characterized by the dominance of males and first-born. These facts were interpreted as pointing up the need for a learning theory explanation, especially since the physiologically aimed research seemed not to offer an explanation of the predominance of male and first-born children.

The learning theory account springs from Miller's approach-avoidance conflict theory, as this theory was reinterpreted in assertion-disconfirmation form. The specific content of the theory of assertion-disconfirmation conflict states that the autistic child, in connection with being first-born and a male, learns over-assertiveness to the point where he is constantly betting on odds, so to speak, that are overwhelmingly against him. He derives these assertions or expectations from parents who allow him to expect too much from the environment and thus allow him to set his sights too high. This condition of over-assertion or too-great-expectations predisposes him to failure, to temper outbursts, and to the general symptom complex associated with autism.

Several deductions from the theory were proposed: The autistic child is not considered to be deficient in sensation but, rather impervious to stimulation not fitting with his momentary assertions. It is further stated that autism is not explained on a physiological basis since known results do not supply an answer to the sex-ordinal position bias associated with autism and with other lesser emotional disturbances; that "excess motivation" rather than deficiency motivation accounts for the autistic child's position vis a vis his environment; and that family background factors, while sometimes a sufficient empirical condition giving rise to autism, do not offer a general enough theoretical explanation of *other* types of situations that may also give rise to serious disturbances in organisms (e.g., experiments, cultural conditions). Some implications for psychotherapy in the form of better control of the child's environment and the diminishing of his assertions are drawn.

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A FURTHER TEST OF THE RÔLE OF DRIVE REDUCTION IN HUMAN CARDIAC CONDITIONING*[1]

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A. INTRODUCTION

The results of our previous experiments (3, 4) on heart rate conditioning led us to the conclusion that the form of the cardiac *CR* was determined by what the heart was doing at the time the shock *US* went off. With a short (2 sec.) shock the heart rate was strongly accelerating at the time of shock-off. Most *S*s under this condition gave an accelerative type of *CR*. With a longer shock (6 sec.) the *UR* was decelerative at shock-off, and *S*s in this group showed predominantly a decelerative type of *CR*. We interpreted these findings to mean that drive reduction was selecting the form of a classically conditioned autonomic response.

As a further test of this interpretation, the present experiment was run. Our plan was to use a very long shock in the hope that heart rate would have returned to normal at the time the shock went off. The predicted results would be no conditioning at all, if the assumption is granted that the heart rate disturbance at shock termination determines the *CR*. A similar prediction of no conditioning could be made if a very short shock were used—one that would be over before the heart had time to change its rate. The two shock durations chosen to fulfill these conditions were 15 sec. and 0.1 sec. respectively.

B. METHOD

1. *Apparatus*

The apparatus has been described in detail in previous reports (3, 4). Briefly, it consisted of an electrocardiograph to measure the heart rate, a 13 *V.A.C.* shock for the *US*, a tone (60 *db*, 512 *c.p.s.*) for the *CS*, and electronic timers for controlling the sequence of stimuli.

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2. *Subjects*

The *S*s were 30 students at the University of Connecticut, 19 males and 11 females. They were assigned at random to the two experimental conditions. All were paid volunteers.

3. *Procedure*

The classical trace-conditioning procedure employed was essentially the same as that described in earlier papers (3, 4); the major change was in the duration of shock employed. One group had a 15-sec. shock, the other a 0.1 sec. shock. Our technique was closely patterned after that of Notterman, Schoenfeld, and Bersh (1).

4. *Pre-Conditioning*

All *S*s were given a series of 10 pre-conditioning trials consisting of the presentation of ten 1-sec. tones spaced at irregular intervals of one to two minutes.

5. *Conditioning*

Immediately following the pre-conditioning trials, conditioning was begun. A conditioning trial consisted of a 1-sec. tone followed in six sec. by a 15-sec. shock for the *S*s of one group, or a 0.1 sec. shock for those of the other. All *S*s were given 11 conditioning trials separated by inter-trial intervals which varied irregularly between one and two minutes.

Cardiograph records were taken on each trial from about 20 seconds before the tone to about 40 seconds after the tone. The *S*s were instructed that they would receive a series of tones and a series of shocks, but the order was not mentioned.

C. RESULTS

1. *Long-Shock Condition*

Figure 1 shows the response of the heart to tone before and after the tone has been paired with a 15-sec. shock. The dotted line represents the mean rate over the 10 pre-conditioning trials of tone alone plotted against ordinal beat number. The unconditioned depression in rate produced by the tone is clearly apparent. The solid line in the lower half of the figure is an average taken over the 10 conditioning Trials 2 through 11. Immediately after the tone-*UR* an accelerative component of the *CR* appears followed by a conditioned deceleration. The shock elevates the heart rate about 6 b/m over the pretone level, but the rate gradually falls while the shock is still on until it reaches pretone level just before the shock goes off. The upper half of Figure 1 is the difference between the two functions in the lower half. It gives a corrected measure of conditioning by subtracting out the effects of the tone-*UR*. All points on the graph are the average of 15 *S*s' data.

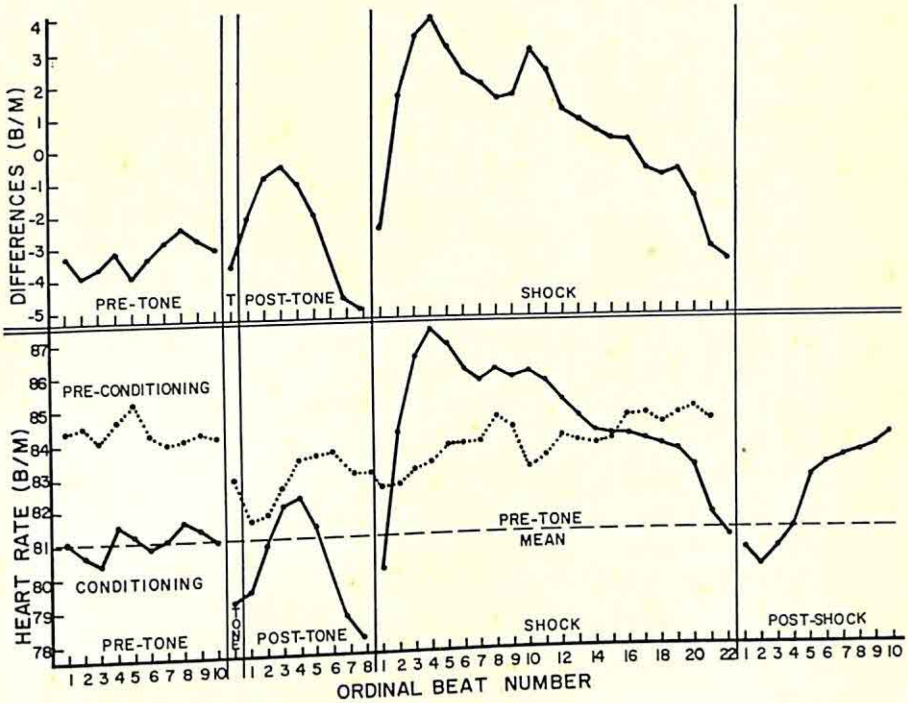

FIGURE 1

The form of the heart rate response during pre-conditioning, and conditioning with the 15-sec. shock is shown in the lower half. The top half represents the difference between the two lower curves.

2. *Short-Shock Condition*

Figure 2 is analogous to Figure 1 with only *US* duration changed to 0.1 sec. With both corrected and uncorrected measures, the *CR* resembles closely the *CR* observed with long shock. The *UR* to shock, beginning after the shock is over, rises to a maximum of 4 b/m over pretone level, then falls gradually over the subsequent 15 beats measured.

D. DISCUSSION

The prediction that no conditioning would occur in either the long or short-shock group was not borne out by the results. A combined accelerative and decelerative type of *CR* appeared under both conditions. Before we abandon our hypothesis that the heart's behavior at the point of drive reduction determines the form of the *CR*, we wish to examine in greater detail what might be happening at the point of shock-off in both groups.

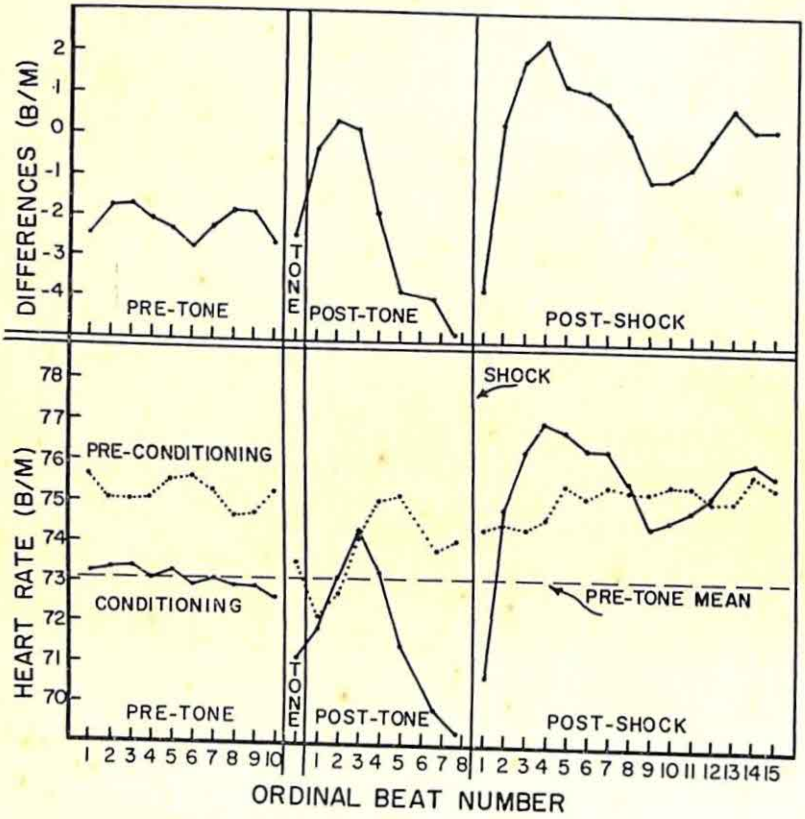

FIGURE 2
THE FORM OF THE HEART RATE RESPONSES IN THE 0.1 SEC. SHOCK GROUP

It will be recalled that our predictions were based on the assumption that the heart would be at its normal pretone level at the time of shock termination. An argument might be made that this condition was not met for the short-shock group. In the first 0.1 sec. shock trial, the heart rate on the beat before shock onset-offset was still slightly decelerative because of the tone *UR*, while on the beat immediately after, the rate was accelerating as a result of the *UR* to shock. Thus the combined accelerative-decelerative *CR* could possibly be the result of drive reduction operating on these two contiguous responses. Even after the *CR* develops, drive reduction is still very close in time to both decelerative and accelerative aspects of the response.

The 15-sec. data, on the other hand, lend themselves less readily to this kind of analysis. At the time the shock went off for this group, the average heart rate was very close to pretone level, although the function did have a downward slope at this point. Since heart rate at the point of shock-off can be decelerative either (*a*) with respect to normal pretone level, or (*b*) with respect to the rate just before shock-off (downward slope), it is important to find out if either of these two response specifications is related to the form of the *CR*.

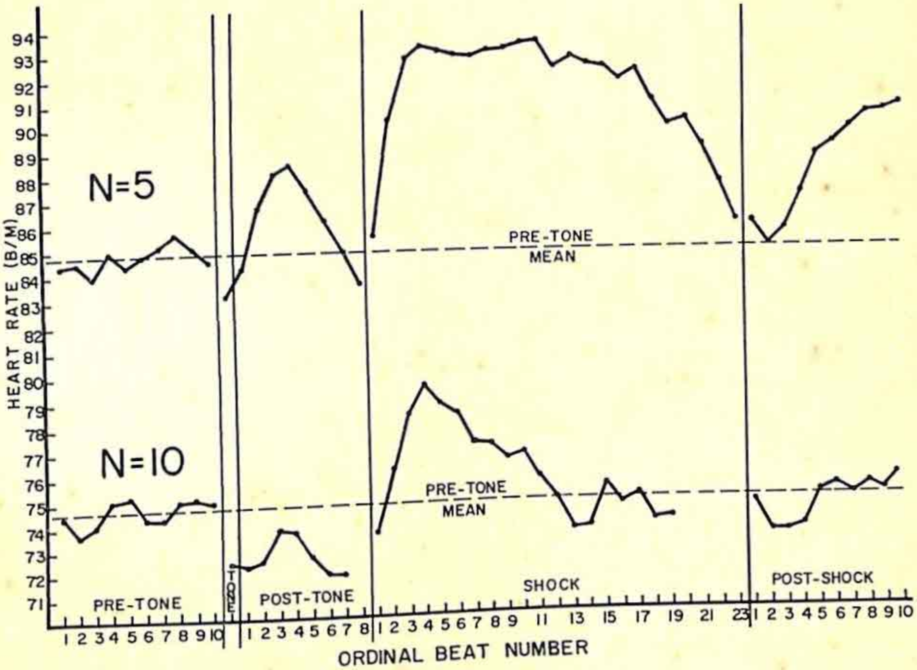

FIGURE 3

The cardiac responses of two subgroups under the 15-sec. shock condition. The lower group (*N* = 10) had a flat response at shock termination; the upper group (*N* = 5) had curves of downward slope at shock-off.

As a test of this, it was possible to find 10 out of our 15 *S*s whose heart rate had returned to normal well before the end of shock. Figure 3 presents their data together with those of the remaining five *S*s whose average rate curve had a downward slope. The outcome of this separation convinced us. The group with the flat response at shock-off surely provides a clear test of our drive reduction hypothesis. If it were true, they should not have conditioned. They did, however, and with a decelerative *CR*. The others showed the accelerative type.

The cause of this difference is not altogether clear. Although the groups were separated on the basis of response at shock-off, there are other correlated differences. The pretone levels of the two groups differ by 10 b/m, and the maximum peaks of the *UR* above pretone level differ by 3½ b/m. Either of these factors could be related to the observed differences in *CR*. To assess the relative importance of these and other factors in determining the form of the *CR*, we have combined the data of our two previous investigations (with 2- and 6-sec. shock) with those of the present study, since both accelerative and decelerative components had been observed to some extent with all four shock durations.

Figure 4 depicts the mean form of *CR* (corrected for tone *UR*) and *UR* of all 63 *S*s conditioned with 0.1, 2-, 6-, and 15-sec. shocks. Various measures of the *CR*, *UR*, and pretone level are indicated. Most of these are adequately defined in the figure with the possible exception of *O* and *S*. The measures $0_{.1}$, 0_2, 0_6, and 0_{15} are the *UR* magnitudes *above* pretone level (those *below* are negative) at the time of shock-off for the 0.1, 2-, 6-, and 15-sec. conditions respectively. Only 0_2 and 0_6 are drawn in the figure. *S* is the index of the slope of the *UR* function at the end of shock. Specifically it is the difference between the rate level on the last shock beat and the first post-shock beat. A downward slope was given a negative sign.

TABLE 1
CORRELATIONS AMONG VARIOUS MEASURES OF THE CONDITIONED AND UNCONDITIONED RESPONSES

	D	U	O	S	P
A	−.36**	+.62**	+.55**	+.22	+.23
C		+.34**	+.15	+.08	+.28*
D		−.24*	−.16	−.09	+.12
U			+.78**	+.19	+.34**
O				+.34**	+.22

**Significant at 1 per cent level.
*Significant at 5 per cent level.

The important correlations among the various measures appear in Table 1. These are Pearson *r*'s obtained by correlating over *S*s in the following way: by taking a mean over all conditioning trials a graph similar to Figure 3 was drawn for each of our 63 *S*s, yielding for intercorrelation 63 individual scores on each of the seven measures.

Among the salient features of the tables are these. The slope (*S*) at shock-off correlates significantly with none of the three measures of *CR* magnitude: *A*, *C*, or *D*. The *UR* level at shock-off (*O*) is positively correlated with the accelerative component (*A*) of the *CR*. This would seem to substantiate the drive reduction hypothesis stated earlier if it were not for the high correlation of *O* with *U* (peak of *UR*), which, as we will

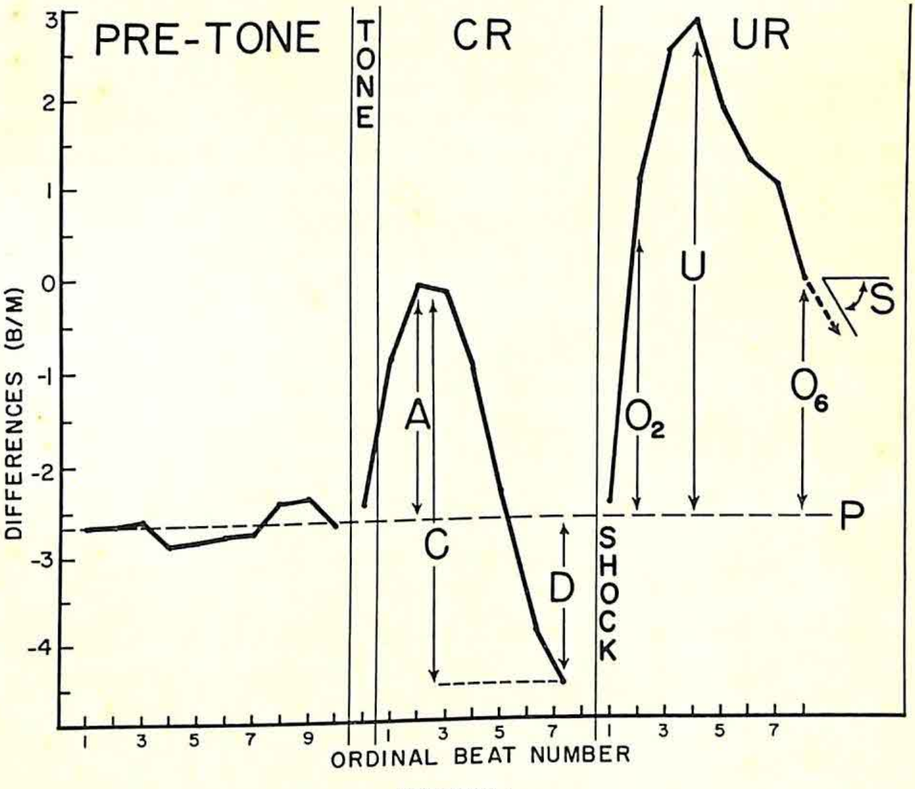

FIGURE 4

The mean corrected form of response for 63 *S*s under the four shock durations of 0.1, 2, 6, and 15 sec. Eight measures are refined graphically:

A: maximum accelerative component of *CR*.

C: total magnitude of *CR*, accelerative (*A*) plus decelerative (*D*).

D: maximum decelerative component of *CR*.

O_2: magnitude of *UR* when the 2-sec. shock goes off.

U: *UR* maximum above pretone level.

O_6: *UR* magnitude when the 6-sec. shock goes off.

S: the slope of the curve at shock-off.

P: mean rate over the 10 pretone beats.

Not shown are $O_{.1}$ and O_{15}, and *S* at the three other places of shock-off.

show, turns out to be the real determinant of *A*. *U* correlates significantly with the three measures of *CR* and with pretone level.

While Table 1 has shown that *P*, *O*, and *U* all have some relation to the three measures of *CR* it was necessary to compute certain first-order partial correlations to estimate the independent influences of *P*, *O*, and *U* on *A*, *C*, and *D*. These are shown in Table 2. Two facts emerge from this table. When *U* is held constant, *P* and *O* do not control *CR*. When, however, either *P* or *O* is held constant, *U* still correlates significantly with at least two measures of *CR*.

TABLE 2

FIRST-ORDER PARTIAL CORRELATIONS AMONG SELECTED RESPONSE MEASURES

	U held constant		*P* held constant		*O* held constant	
	O	P	O	U	U	P
A	+.13	+.03	+.53**	+.59**	+.37**	+.14
C	—.20	+.18	+.10	+.27	+.36**	+.26
D	+.05	+.22	—.20	—.30*	—.20	—.17

**Significant at 1 per cent level.
*Significant at 5 per cent level.

The major conclusions to be drawn from the correlational analysis may be enumerated:

1. What the heart is doing at the point of drive reduction (*O*, *S*) is not directly related to the form of the *CR*.
2. The *UR* maximum does appear to control the form of the *CR*; *S*s with larger *UR*'s tend to give the accelerative type of *CR*; *S*s with small *UR*'s tend toward the decelerative type of *CR*.

These conclusions stand in marked contrast to those derived from previous studies with 2- and 6-sec. shocks. That the 2-sec. shock condition gave rise to mostly accelerative *CR*'s and the 6-sec. shock mostly decelerative is a fact which we must now re-interpret to mean not that drive reduction was selecting the form of the *CR* but that the 6-sec. condition had a larger proportion of *S*s with relatively small *UR*'s and the 2-sec. condition a larger proportion of *S*s with greater *UR*'s.

Why these conditions should have such disproportionate numbers of the two types of responders is not known to us. A systematic relationship between *US* duration and *UR* magnitude might explain it, but no such relationship exists (2).

We are not now in a position to state with confidence what the mechanism of conditioning of this autonomic response might be, other than to deny the simple drive reduction view we started with. We suspect that different breathing patterns might be related to our two types of responders, since inhaling and exhaling produce heart acceleration and deceleration respectively, of approximately the same order of magnitude as those observed. Our future investigations will explore this possibility.

E. SUMMARY

This study provided some new tests of the hypothesis that the form of a cardiac *CR* is determined by the action of the heart at the point of shock termination (drive reduction). The heart rate responses of two groups of 15 human *S*s were classically conditioned with a very long shock (15 sec.) and a very short shock (0.1 sec.) with the prediction from our hypothesis that no conditioning would result. Both groups conditioned. Two forms of *CR*, accelerative and decelerative, were again observed. A correlational analysis of the data from experiments with 0.1, 2-, 6-, and 15-sec. shocks showed that it was the maximum amplitude of the *UR* rather than the heart rate at shock-off that was related to the form of the *CR*. These results are inconsistent with the view that drive reduction plays a rôle in the classical conditioning of this autonomic response.

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EFFICIENT RETENTION AND TRANSFER AS AFFECTED BY LEARNING METHOD*[1]

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A. PURPOSE

In his work on problem-solving, Katona (2) concluded, in general, that learning guided by an attempt to organize the elements of a task into meaningful relationships was more efficient than learning by memorizing the elements. Melton (3) has questioned the validity of Katona's conclusions, criticizing particularly the lack of precise definitions and statistical rigor. Recently Hilgard *et al.* (1) found at least one result which was different from that reported by Katona. Whereas the latter reported that learning by "understanding" was superior to learning by "memorization," both in terms of recall and transfer, Hilgard and his co-workers found that this superiority was not evident in recall.

The present study had two aims: (*a*) to clarify the confusion concerning recall; (*b*) to determine whether the understanding method could be improved.

B. METHOD

1. *Subjects*

The 39 *S*s, all females enrolled in the course in elementary psychology at the University of Pennsylvania during the fall of 1955, were randomly assigned to one of three groups as specified below.

2. *Procedure*

All data were collected in two sessions, with one week's separation between them. The initial learning of a task was completed during the first session while recall, simple transfer, and transfer involving problem-solving was tested during the second session. The *S*s were tested in groups of three. During Session 1 each of the three groups was given a different experimental treatment. Each *S* was required to learn a new 26-symbol alphabet.

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[1] Revised version of paper read at Annual Convention of Eastern Psychological Association, held in Atlantic City, 1956.

The difference in treatments consisted in the fact that the method of learning differed for each of the groups.

Group *O*, the observer group, was presented with a list containing the 26 symbols, each symbol being paired with an English letter equivalent as shown in Figure 1. These *S*s received written instructions explaining the principle on the basis of which the alphabet was constructed. Group *P*, the participant group, was given the same list, but were only told that there was a principle and were required to describe, in writing, what the principle was. Group *M*, the memorization group, was given the same 26 symbols and English letter equivalents, but rearranged so that the *S*s could not easily detect the underlying principle. No formal trials were given. The *S*s presented their material for correction whenever they thought they had completed it correctly.

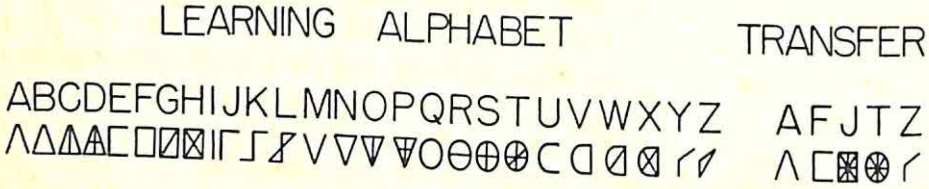

FIGURE 1
AN IDENTICAL REPRODUCTION OF THE SYMBOLS AND THEIR ENGLISH LETTER EQUIVALENTS WHICH WAS GIVEN TO THE OBSERVER GROUP DURING THE PRELIMINARY LEARNING PERIOD AND THE TRANSFER PERIOD
(See text for further clarification)

Two criteria of learning were used uniformly for all three groups. First, each *S* was required to learn the list until she achieved two successive errorless reproductions. It is interesting to note that Group *M* took approximately twice as long as the other two groups to reach this criterion. To ensure that all *S*s reached the same level of performance, each *S* was also required to translate *without error* a paragraph written in the symbols learned. Each *S* was able to reach this second criterion within 15 minutes. At the conclusion of Session 1 all *S*s were told to return for additional testing in one week.

During Session 2 three tests were administered. The recall test consisted of a passage written in the symbols learned during Session 1, with the *S*s being required to translate the passage into English within 15 minutes. The second or transfer test was very similar to the first one; *S*s were again given a passage written in a symbol system and were allowed 15 minutes to translate it into English. They were told that the code system was slightly different from the system learned before, and were given a few key symbols from which it was possible to derive the entire code. This code was very similar to the first one except that each group consisted of five letters instead of four, with "z" forming the last group. It is quite clear from inspection of Figure 1 that this test was merely one of transfer involving simple transposition.

The last, problem-solving, test consisted of a passage written in symbols differing markedly from the symbols used in previous tests. In this system the alphabet was again divided into groups of four letters. The first group consisted of *A*, *B*, *C*, and *D*; the second group of *E*, *F*, *G*, and *H*; and so on, with *Y* and *Z* constituting the seventh group. Each letter, in addition to having a number standing for its particular group also had a number referring to its own position in that group. In this way "*B*" was called "*12*," the *1* standing for the first group in the alphabet, and the *2* standing for the fact that *B* is second in the group. The letter *E* was written as "*21*" with the *2* standing for the second alphabet group, and the *1* standing for the fact that *E* is the first letter in this group. *Y* was written as "*71*," using the same principle. *S*s were told that two digits represented one letter, and were also given some of the key symbols, together with their English letter translations. *S*s were allowed 15 minutes to translate the passage. In each test the score consisted of the number of words translated correctly.

C. Results and Discussion

The Kruskal and Wallis (4) non-parametric analysis of variance was performed on the data of all three tests. The mean score for Groups *P*, *O*, and *M* are given below in that order. On the recall test the means were 52, 50, and 37; on the transfer test, 31, 30, and 11; on the problem-solving test, 37, 34, and 10. The differences are significant ($p < .001$). Comparison of individual groups showed that only the differences between Group *M* and the other two groups were significant. It should be stressed that 52 was a perfect score on the recall test.

Two conclusions are warranted. First, the "participant" and the "observer" groups were superior to the "memorization" group on the recall test. Second, both of these understanding groups were also superior to the "memorization" group on both transfer tests.

Now, how can one best account for these facts? Let us take the case of the recall test first. It seems quite clear that learning by understanding principles does make recall easier than learning by memorizing elements. The most probable reason for this difference is that the individuals who learned by "understanding" merely remembered the principle underlying the construction of the symbols. One therefore expects that the probability of the memorization group forgetting some symbols is greater since they have many more elements to remember. On the other hand, one would not expect any difference between the participant and the observer groups since both of these groups knew what the principle was which they remembered. It should be emphasized that the principles in this study were clearly defined and relatively easy to remember and that our differences between the two "understanding" groups and the memorization group were very large. The principles in the Katona card-trick problems, which were used in previous studies (1, 2) were rather obscure; one does not really know whether *S* really understood the principle or whether he merely memorized it. This is the probable reason why some *S*s showed superior recall while others did not. But in the present study where the principle to-be-remembered was clear, the understanding groups were unquestionably superior in recall to the memorization group.

Now, since the participant and the observer groups were trained to organize the learning material according to the principles underlying their construction it is to be expected that they would be superior in this ability. The fact that these two groups did three to four times as well as the memorization group on transfer and problem-solving supports this proposition. We had thought that the participant group would be even more superior than the observer group since the former had received additional practice in "looking-for" principles. But this additional practice, compared to the experiential backgrounds *S*s brought to the experiment, was insignificant. However, it is also evident that the transfer tests were probably too simple to detect differences between these two groups: each made high scores. These variations in teaching methods should produce greater effects if they are started earlier in the individual's educational development. This study has indicated that learning by principles leads to much greater efficiency in recall and transfer than learning by memorizing. One could hardly expect Group *M* to show transfer since the symbols were quite different. However, this study does indicate the marked efficiency of principle learning in general. It should be recalled that previous work (1) even questioned the superiority of principle learning when recall was tested.

D. SUMMARY

Three groups of *S*s were required to learn a new alphabet under different conditions. Group *M* merely memorized the alphabet list. The principle underlying the alphabet construction was explained to Group *O*, while

Group *P* discovered it for themselves. The results of a recall test and two transfer tests indicated that learning by principle is generally superior to rote learning.

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A METHODOLOGICAL DISCUSSION OF NONVERBAL BEHAVIOR*

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The behavior of the organism in any interpersonal situation can be classified into three categories: verbal, vocal, and nonverbal. These three types of behavior can be distinguished in terms of their medium of expression, the manner in which they are perceived, their developmental sequence, and their communicative value.

Verbal behavior, which can be defined as the content of an organism's spoken statements, and vocal behavior, the timbre, pitch, and intensity of a spoken statement, are both motor expressions originating in the pharynx. Nonverbal behavior, which is defined as the body movements of the organism, also consists of motor expressions, though they may originate in various parts of the body. Verbal and vocal behavior are similar in that they are both perceived through the auditory senses. Nonverbal behavior is chiefly perceived through the visual sense organs, though occasionally this is supplemented by auditory and tactual sensations.

The organism learns about both itself and its surroundings and communicates chiefly through nonverbal and vocal behavior during the earliest part of its life. Later, verbal behavior emerges and it tends to become the form of communication which commands most attention. Nonverbal and vocal behavior are also alike in reference to their later communicative value. All three forms of behavior have both consensually validated linguistic or symbolic meaning, and more private or autistic connotations. Verbal far exceeds vocal or nonverbal behavior in degree of codification and consequent symbolic use. Although some gestures, postures, facial expressions, and vocal inflections, achieve definite symbolic usage, for the most part vocal and nonverbal behavior are less defined as to their meaning or intent.

The basic assumption, however, in this discussion, is that although non-

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verbal and vocal behavior after early childhood come to be largely ignored for purposes of conversation, they do have significant communicative value. The organism tends to both communicate by means of and react to nonverbal and vocal cues, regardless of whether the individual enacting the behavior, the actor, or the individual perceiving it, is able to report the use of these media of communication.

Nonverbal behavior may be conceived as supplying two types of information which may or may not correspond to verbal behavior. It may have a specific direct meaning. This type of nonverbal behavior may emphasize, contradict, aid in the interpretation of, or have little relation to a verbal statement. Nonverbal behavior may also have a more general significance, providing information about such variables as activity level, and the accumulation and discharge of tension or anxiety during a specific time period. The implications of this distinction, the problem of the differential effects of efforts to control or censor communication upon verbal, vocal, and nonverbal behavior, the complications provided by the differences in amount of agreement between individuals as to the meaning of specific nonverbal acts, and a review of some of the evidence supporting the previous assumption as to the communicative significance of nonverbal behavior, have been discussed elsewhere (2, 4, 6).

The present paper will be concerned only with those aspects of nonverbal behavior which are observable and can be assumed to provide cues both for the actor and the perceiver. Nonverbal behavior which supplies cues only to the actor, such as an increase in heart beat, or a muscle twitch occurring in a place covered by clothing, and which therefore can have communicative significance solely for the actor, will not be considered. The form of nonverbal behavior, then, which will be pertinent to this discussion, will be those motor responses, such as gestures, postures, facial expressions, and other less defined actions which are observable to both actor and perceiver.

Although global methods of recording, which give hope of preserving the gestalt qualities of a situation, may appear to be most appropriate to the study of nonverbal behavior, their advantage may prove to be illusory. Essentially, global methods, which are most closely approximated by motion pictures or tape recording techniques, are of little help to the experimenter other than providing a permanent record of some of the stimuli present. Unless the data are obviously meaningful from initial inspection, the mere amassing of them in great quantities has no inherent merit. The problem of the selection of variables to be analyzed still remains, for the data collected by global techniques are often of the same order of complexity as the original behavior itself.

In attempting to select those nonverbal responses to be studied, the fluidity of this type of behavior poses special difficulties, in that there are no apparent or natural divisions in its occurrence. While verbal behavior may readily be analyzed into units of words, sentences, or utterances, nonverbal behavior is continually occurring or being enacted, with no such obvious separations apparent.

Nonverbal behavior may be viewed as displaying various positions and movements occurring between positions. Positions can be conceived as any prescribed discrete aspect of motor behavior. Facial expression, gesture, and posture are among the most familiar positional variables. Movement can be thought of as that which takes place when an individual changes from one position to another. Movement variables are magnitude and speed. Before any selection or analysis occurs, all nonverbal behavior consists of movements, apart from those which we have previously learned to identify and separate out as positions, such as frowns or slouching. Actually, movements are merely the undefined mass of rapidly occurring positions. If treated only as movements, nonverbal behavior is relatively useless, since, as such it can be neither recorded nor analyzed. Recording devices can deal only with positions. The motion picture camera differs from other techniques only in that it takes more samples of positions per second and thus can produce the visual effect of recording movement. The investigator must specify certain positions and separate them through his recording techniques from the mass of positions which is continually occurring.

Positions may be classified into discrete response categories. Each category, such as posture, hand position, leg position, includes an almost endless number of separate alternative motor behaviors. When nonverbal behavior is viewed in terms of these categories it is always continuously being enacted. The separate responses within each category, however, vary as to the frequency of their occurrence, and may be said to be either present or absent at a specific moment.

Rate measures of the frequency of occurrence of the nonverbal responses within each category selected, form the basic methodological procedure advocated in this paper. Skinner (7) has pointed out that probability of action, which can be determined through recording the frequency of occurrence of a specified response, is perhaps the most basic datum of psychology. Information as to the future behavior of the organism is provided, and principles for controlling and manipulating that behavior can be derived. In regard to the study of nonverbal behavior, rate measures furnish data which are easily related to both experimental variables and other ongoing behaviors being recorded. An advantage found in the use of rate measures is the possibility of having a subject serve as his own control, by recording his behavior before and after the introduction of an experimental variable.

The actual research utility of rate measures of nonverbal behavior will differ depending upon whether the communicative or the expressive aspect of nonverbal behavior is being considered. In any interpersonal setting, either the effect of a non-personal situational factor upon the behavior of each subject, or the effect of the behavior of one subject upon the behavior of another subject, can be studied.

The expressive aspect of nonverbal behavior may be investigated by studying the effect of changes in the task, instructions, or other situational variables on the nonverbal behavior of each subject. Changes in the rate of occurrence of specified nonverbal responses are related to the introduction of such experimental variables as frustration, conflict, or stress. Each subject is studied separately, and the communication and interaction between subjects present in a group can be ignored.

The communicative aspect of nonverbal behavior may be investigated through studying the effect of the verbal and/or nonverbal behavior of one subject on the verbal and/or nonverbal behavior of another subject present in a group. Changes in the rate of occurrence of specified nonverbal acts for one subject are related to changes in the rate of occurrence of that same specified nonverbal act, other nonverbal actions, or the verbal behavior of another subject.

Whether studying the expressive or communicative aspects of nonverbal behavior, one serious limitation found in the present methodological approach is in regard to nonverbal responses which occur infrequently. Although quite possibly important nonverbal responses which occur infrequently can not be handled with this methodology.

Sampling procedures must be developed in order to take rate measures of specific alternative responses within any of the nonverbal response categories. As was mentioned earlier, all recording devices only take samples of nonverbal responses. The specific apparatus employed for recording will dictate the number of samples which it is possible to take during any time interval. For example, the typical motion picture camera takes 16 samples each second. The recording equipment will also act to determine the number of different categories which can be recorded in a sampling period, and the number of alternative specific responses which can be recorded for each category.

The choice of nonverbal response categories and of the specific alternative responses within each category to be recorded must at this time, because of the relative paucity of experimental data, be dependent upon the particular preferences of the investigator. Reliance can be placed on his previous experience, pilot studies, or the empirical and theoretical guides offered by other investigators (2, 3, 4, 5, 6).

While many investigators have been interested in interpreting the nonverbal behavior displayed by subjects in various situations, few actual methodologies have been devised which permit this type of analysis to be performed upon the basis of systematic recordings of the behavior itself. Bales (1) has developed one of the most detailed methodologies for recording behavior in small groups. His observers classify various aspects of behavior into a set of 12 predetermined interpretative categories. Although Bales' chief concern has been verbal behavior, his techniques also incorporate judgments made upon the basis of certain forms of nonverbal behavior. Nonverbal cues form the basis of the observer's classification decisions only when the observer is certain as to the meaning of that behavior, and when he is also able to fit it into one of the 12 categories. This requirement probably has the effect of limiting the observer to the use of the most conventional and stereotyped forms of nonverbal behavior. Interpretative recording, which Bales claims to be the heart of his method, would seem to be more appropriate to verbal behavior, where the meaning of the behavior is more likely to be obvious, than nonverbal behavior, in which many actions are ambiguous or uncertain.

Bales has stated that "interaction process analysis" cannot be readily performed from a tape recording of a group's behavior, which includes only verbal and vocal behavior. He states that analyses made from tape alone differ and are not as accurate as those made from direct observation of behavior. This would seem to indicate that despite the fact that his techniques do not systematically record or interpret nonverbal behavior, they rely extensively upon nonverbal cues in the discriminations and inferences that are made about verbal behavior.

Birdwhistell (2) has devised a seemingly comprehensive system for recording nonverbal behavior which relies upon written symbols being transcribed while the behavior is occurring. Despite the fact that the use of such a notational system would act to unnecessarily curtail the amount of behavior which could be recorded, since the observer is required to spend a good deal of his time making the notations, Birdwhistell makes no provision for sampling procedures. The use of written symbols would appear to be uneconomical in regard to both the training of observers and the later tabulation of data. His work is of considerable use, however, in that he presents a formidable catalogue of possible nonverbal responses which might be recorded.

The methodological approach described in this paper was applied in a study of a three-person group in which mimeographed cards were used for recording rate measures of selected nonverbal response categories (4). A separate card was used for each response category; on each card the possible alternative responses which were to be considered for each category were drawn in picture form. Thus, for example, the response category of body posture was recorded on a card on which five different alternative body postures were drawn. The observer's task was to record which of the alternative responses was being enacted during each sampling period. A separate observer was assigned to record the behavior of each subject from behind a one-way vision screen. A timing device was employed which gave both a signal for the observer to pick up the appropriate card, and a signal to record the response occurring at that specific moment. Five response categories were recorded, with each category being sampled once each minute.

The data obtained from this technique or from any other technique which follows the general methodological procedures outlined, are amenable to a variety of treatments. Statistical tests could be made for each response category comparing the frequency of occurrence of a certain class of behavior before and after the introduction of the experimental variable. In a specific application of the card technique, it was possible to treat statistically differences before and after the introduction of frustration (4).

Cumulative frequency curves could be graphed for each alternative response. The relationship of each response to the experimental variable could then be studied in more detail. The relationship of one type of response to another for each subject during specific intervals could be analyzed. The changes in rate of occurrence for the various nonverbal categories could be compared with the verbal behavior of each subject. The effect of a specific nonverbal or verbal response of one subject on the rate of occurrence of that same specific response, or on other aspects of nonverbal or verbal behavior for another subject could be analyzed.

Since the cards had pictures drawn on them for the different responses the training of observers was relatively simple. The cards also were economical in regard to their cost, and in terms of the ease with which the data could be tabulated.

The disadvantages found in this procedure can be remedied through a further elaboration of techniques without departing from the basic methodological approach. One of the chief difficulties encountered was that of controlling the amount of time spent observing before each response was recorded on a card. The timing device described permitted control over when an observer began to look at a subject but not over how long he looked before he recorded the response called for on a particular card. It became obvious that a different amount of time was necessary for observing for each of the response categories studied. It was not possible, however, to be sure that an observer spent the same amount of time observing a specific response each time that response was sampled, and it was probable that there were differences between the observers in the time spent observing each response category. One possible solution to this problem would be the use of a tachistoscopic device which would expose the subject's behavior for a specified period of time to all the observers simultaneously. The tachistoscopic device would also permit alterations in the exposure time for each response category.

The type of recording technique employed determines the number of samples which can be taken, and the number of categories and responses within each category which can be recorded in each sampling period. With the use of the cards, samples could be taken only five times each minute. In order for the observer to be able to make his recording quickly and with a minimal amount of confusion, there could be only four or five alternative responses drawn on each card. Thus if it were necessary to have each category sampled for each subject once a minute, only five categories, each having at most five alternative responses, could be recorded. One way the number of categories sampled could be increased would be through assigning more than one observer to each subject.

The number of alternative responses, and possibly also the number of categories, which one observer can record could be substantially increased through the use of a 20-pen operations recorder connected to a push-button switching system. One set of buttons could be used to indicate the category being recorded; another set being used to record the particular alternative response observed. In this fashion a record would be acquired on which up to 10 response categories, each one of which had up to 10 alternative responses would be indicated along a time continuum. With this procedure, however, the training of observers, and the tabulation of data would become more complicated processes.

Another solution to the problems mentioned would be the use of a stop motion picture record, with samples being taken as frequently as desired. Although it might seem that this technique would sample all response categories simultaneously, the focus of the lens, the angle of the camera, and other such technical factors act to select only certain responses for exposure on the film. The chief virtues of the photographic techniques are in providing more samples per minute than other devices allow, and in producing a permanent record of some of the stimuli present from which rate measures for more different response categories, than is usually possible from direct observation, can be made. Motion pictures might also be used to check the reliability of observers recording nonverbal behavior directly.

During the early stages of experimentation, when little work has been done to isolate or study response categories, it is questionable whether photographic records are useful or necessary. It might be wiser, initially, to use simpler techniques recording a small number of categories from direct observation. Later, when a number of categories have been studied, and theoretical formulations about both the meaning and use of nonverbal cues are more advanced, research on a more complex level might be undertaken in which the cost of using photographic techniques would be overruled by the necessity of dealing with larger numbers of categories simultaneously.

SUMMARY

Nonverbal behavior can be distinguished from verbal and vocal behavior in regard to its medium of expression, the manner in which it is perceived, its rôle developmentally, and its communicative significance. Only nonverbal behavior, which is defined as the body movements of the organism, which is observable and thus of communicative significance to both an actor and a perceiver was considered in the present paper.

Global recording techniques were found to be of little use in helping the investigator gather data, but instead provide information as complex as was the original behavior itself. Before any analysis or selection takes place, nonverbal behavior consists of various movements. As such it is relatively intractable to analysis. Movements are merely the undefined mass of rapidly occurring positions or discrete responses. The investigator must select out from the mass of responses those which he is interested in studying.

Rate measures of the frequency of occurrence of specific nonverbal responses form the basic methodological procedure. The type of recording device employed determines the number of samples which can be taken in a specified time interval and the number of response categories which can be recorded.

In a specific application of the methodological procedures discussed, mimeographed cards were utilized to record the behavior of a three-person group.

A separate card was used for each response category, with the specified alternative responses in each category drawn on each card.

Various ways of analyzing the data obtained from rate measures of nonverbal behavior were presented. Statistical tests can be made on the frequency of occurrence of a response before and after the introduction of an experimental variable. Cumulative frequency curves for each response can be graphed. This would permit analysis of the relationship of one response to another, of the relationship of the behavior of one subject to that of another subject present in the group, and of the relationship between the nonverbal and the verbal behavior.

Advantages and disadvantages of the card techniques were presented. An elaboration of techniques which would remedy the difficulties encountered without departing from the basic methodological procedure were offered. The use of a tachistoscopic viewing device and a 20-pen operations recorder would enable better control over time spent observing, and would allow the investigator to record up to 10 categories and up to 10 alternative responses within each category.

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A NORMATIVE STUDY OF THE EDWARDS' PERSONAL PREFERENCE SCHEDULE*

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A. PROBLEM

The Edwards' *Personal Preference Schedule* (*PPS*) was developed ". . . primarily as an instrument for research and counseling purposes, to provide quick and convenient measures of a number of relatively independent *normal* personality variables" (1, p. 1).

The two major aspects of this personality inventory are: (*a*) minimization of social desirability as an influencing factor in the subject's responsivity by pairing items of equal degrees of social desirability; (*b*) evaluation in terms of 15 personality variables[2] which derive from Murray's (2) system of needs. Here the attempt is to get away from the usual diagnostic classifications. The 15 needs are more suited to an analysis of the reasons for individual behavior than to describing the person as "emotional" or "submissive," etc. The latter behavior may be observed but causes have to be inferred. In the *PPS* assessment the behavior is referred to the significant underlying needs. The need labels are: Achievement (*ach*), Affiliation (*aff*), Intraception (*int*), Succorance (*suc*), Dominance (*dom*), Abasement (*aba*), Nurturance (*nur*), Change (*chg*), Endurance (*end*), Heterosexuality (*het*), and Aggression (*agg*). A Consistency (*con*) variable measures the extent to which the subject is being consistent in his responsiveness to the paired schedule items.

The original college standardization population consisted of 1,509 subjects (760 males and 749 females). This paper discusses the mean variable raw and *T* scores for the standardization group and for a group of 130 undergraduate students (82 males and 42 females) at the University of Miami.

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[1] This study was made possible by a grant from the Penrose Fund of the American Philosophical Society. The assistance of Dr. Raymond E. Hartley and Mr. Don Lichtenstein of the Department of Psychology, University of Miami, is appreciated.

[2] The variables are defined in Edwards (1, p. 5).

B. Results

Table 1 presents the mean raw and *T* scores, the *SD*, and the significance of the differences for Edwards' standardization (*ES*) and the present study (*PS*) populations. From Table 1 it may be noted that for the males eight of the 16 variables show larger mean raw scores for the *ES* group than for the *PS* group. Only two of these yield significant differences: Abasement shows a reliably higher mean score for the *ES* males while Intraception favors the *PS* males. Both differences are significant at the .01 and .001 levels respectively.

The mean raw scores for the female groups show four significant differences. In two of these, Affiliation and Abasement, the *ES* females are higher ($p = .03$ and .001 respectively). The remaining two, Achievement and Heterosexuality, favor the *PS* female group at the .03 level of significance.

C. Discussion

Six categories of variables showed significant differences between the *ES* and *PS* groups. This number is beyond pure chance expectations. However, the absolute sizes of these statistically significant mean raw scores (and their standard deviations) would seem to mitigate the impact of the obtained differences. This is entirely supported when these raw scores are converted into *T* scores. It may be seen from Table 1 that all of the *T* values for the 32 variables vary between 45 and 57, well within Edwards' "average" range. This latter is sufficient to justify the conclusion that the *ES* and *PS* groups do not differ in terms of their manifest needs as these find expression in the *PPS* items.

It might be speculated, however, that the five variables in which the males and females of the two populations were at variance with regard to mean raw scores do suggest some differences in the personality makeup of the *ES* and *PS* groups. Edwards' Manual (1) does not give details with regard to the sources of the *ES* normative population. However, the list of acknowledgments of colleagues who helped gather the normative data justifies the impression that the *ES* group includes students from universities in every section of the country. The resulting raw score norms, therefore, are representative of a heterogeneous college population sample. The *PS* students are drawn from one university and may be considered to be a sample of a much more homogeneous population than the *ES* group. Implied in this statement, and supported by the results of this study, is the assumption that the predominating state college males and females as a group differ in

TABLE 1

MEAN RAW SCORES, *SD*'S, SIGNIFICANCE OF DIFFERENCES, AND *T* SCORES OF *ES* AND *PS* MALE AND FEMALE GROUPS

		Ach		Def		Ord		Exh	
		1*	2†	1	2	1	2	1	2
MALE	ES	15.7±4.1	50	11.2±3.6	50	10.2±4.3	50	14.4±3.5	50
	PS	16.8±4.7	52	11.0±3.4	49	9.7±4.0	49	14.4±3.7	49
	Diff	1.1		—.2‡		—.5		0	
	t	1.8		.4		.77		0	
FEMALE	ES	13.1±4.2	50	12.4±3.7	50	10.2±4.3	50	14.3±3.6	50
	PS	16.0±8.1	57	12.0±4.1	49	9.6±3.9	49	14.3±3.8	49
	Diff	2.9		—.4		—.6		0	
	t	2.2**		.51		.72		0	

		Aut		Aff		Int		Suc	
		1	2	1	2	1	2	1	2
MALE	ES	14.3±4.4	50	15.0±4.3	50	16.1±5.2	50	10.7±4.7	50
	PS	14.4±4.7	49	13.9±4.5	48	18.7±4.9	55	9.8±4.4	48
	Diff	.1		1.1		2.6		—.9	
	t	.14		1.6		3.3**		1.3	
FEMALE	ES	12.3±4.3	50	17.4±4.1	50	17.3±4.7	50	12.5±4.4	50
	PS	12.9±4.5	52	15.7±3.9	47	18.7±5.1	53	12.7±5.2	50
	Diff	.6		—1.7		1.4		.2	
	t	.67		2.1**		1.4		.19	

		Dom		Aba		Nur		Chg	
		1	2	1	2	1	2	1	2
MALE	ES	17.4±4.8	50	12.2±4.9	50	14.4±4.8	50	15.5±4.7	50
	PS	16.6±4.8	48	10.1±5.2	45	13.2±4.8	48	15.9±4.3	51
	Diff	—.8		—2.1		—1.2		.4	
	t	1.2		2.7**		1.8		.57	
FEMALE	ES	14.8±4.6	50	15.1±4.9	50	16.4±4.4	50	17.2±4.9	50
	PS	15.1±4.6	52	11.1±5.5	42	15.8±4.4	49	16.8±4.5	50
	Diff	.3		—4.0		—.6		—.4	
	t	.31		3.8**		.67		.42	

		End		Het		Agg		Con	
		1	2	1	2	1	2	1	2
MALE	ES	12.7±5.3	50	17.6±5.4	50	12.8±4.6	50	11.5±1.9	50
	PS	12.9±4.6	51	18.6±5.0	52	12.9±4.2	50	11.0±1.9	47
	Diff	.2		1.0		.1		—.5	
	t	.26		1.2		.14		1.7	
FEMALE	ES	12.6±5.2	52	14.3±5.4	50	10.6±4.6	50	11.7±1.7	50
	PS	12.9±5.1	51	16.5±4.6	54	10.6±4.5	50	12.1±1.8	52
	Diff	.3		2.2		0		.4	
	t	.29		2.1**		0		1.1	

*1 = Mean and Standard Deviation.

†2 = *T* score.

‡ = = sign, *ES* higher.

** = *t* of 2.58 significant at 1 per cent level; 1.96 at the 5 per cent level.

some personality aspects from the private university group of students.[3] In the process of converting these raw scores into a standard score distribution by setting the arbitrary mean at 50 with a standard deviation of 10 (*T* score) the small absolute differences between the *ES* and *PS* mean raw scores were reduced. The resulting *T* scores reflect this in the form of the "average" characterization for all converted scores falling between plus and minus one standard deviation from the arbitrary mean. In the light of the obtained *T* scores, the present study offers further normative data in support of Edwards' original norms.

D. SUMMARY AND CONCLUSIONS

The present study is concerned with ascertaining the relationship between Edwards' *PPS* standardization group mean raw and *T* scores and those obtained from a local group of 130 undergraduate students. The distribution of the mean raw scores for the 16 *PPS* variables yielded six need-categories in which significant differences between the two populations exist. However, these differences disappear when the raw scores are converted into *T* scores. All of the mean raw scores fall into the "average" category. The conclusions may be drawn that: (*a*) the findings in the present study support Edwards' norms; (*b*) the local undergraduate student sample, as a group, does not differ significantly in the expression of needs from the standardization group. Some speculations are offered with regard to the possible sources of the variance in five variables based on the mean raw score data.

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[3] The sole authority for this statement is the actual count of universities listed in Edwards' (1, p. 16) *Manual*: 20 state and seven private universities. The proportion would seem to indicate that the former institutions furnished the greater number of students in the normative group.

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THE EFFECT OF REPETITION UPON THE ENJOYMENT OF MODERN MUSIC*

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A. PROBLEM AND PROCEDURE

The interest of the writer in making the present investigation came from her dislike of certain types of serious contemporary music, and also, to speak frankly, from a bit of pique at the assertion of some persons, more musically sophisticated, that she should be more familiar with this music before passing judgment upon it.[1] "Familiar" can, of course, refer to a number of things, especially perhaps to the sound of the notes, to the sight of the score, to the basic theory of construction. This study is concerned with only the first of these references, for the view taken here is that though appreciation and interest may be enhanced from various other sources, the primary and essential source of appeal must be made to the ear, which member might well stand out boldly and proclaim:

> "If she be not so to me,
> What care I how fair she be?"

Because of their explicit departure from various traditional principles of musical composition, characteristic examples of the mature work of Schoenberg and Hindemith were chosen for this study: LP recordings of Schoenberg's String Quartet III, Op. 31, first movement, played by the Kolisch String Quartet; and of Hindemith's String Quartet IV, Op. 32, second movement, played by the Guilet String Quartet. Schoenberg in this excerpt uses a tone-row based on the 12-tone scale,[2] with strikingly unmelodic, a-tonal, and dissonant effect. Hindemith, using his unique system of changing tonality based on the roots of the tone combinations, also produces an effect quite different from that of classical tonality as well as one of considerable dissonance, though diatonic, degree-wise melody is prominent, and

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[1] There has also been, as everyone knows, a good deal of public controversy concerning the value of modern music. See, e.g., the opposing views of Henry Pleasants and Aaron Copland in the *N. Y. Times*, Magazine Section, March 13, 1955.

[2] I.e., all 12 tones of the chromatic scale are used in a fixed sequence, so arranged that no tonality is suggested by any part thereof. The sequence may then be fragmented, inverted, have its notes disposed in different octaves, etc.

dissonance is not so extreme or so fundamental as in Schoenberg. Both selections are largely polyphonic.

Is it true, then, that repeated hearing of these selections brings out their charms? Must the music, perhaps, be positively liked, at least a little, at first, if it is to be *well-liked* at last? Further, if the music is enjoyed, how much is it enjoyed first and last? What parts are liked best; what parts least, and why? How consistently are the favorite passages preferred? What is the actual musical character of the passages most and least liked? And finally, can any conclusions drawn from these data be reasonably applied to the aesthetics of music in general?

The 16 observers (*O*s), young women from 19 to 22 years of age, were all music students at Sweet Briar College, who were recommended for this investigation because of their "musicality" by members of the Music Department of the college. It seems to the present writer that they were highly suitable to the purpose—old enough to have shown their musical colors, but not old enough to be too completely dyed in them to take on some new ones. They were intelligent, modern young women, largely classically trained, but familiar, as well, with modern musical idioms. They served one at a time for two sessions of one hour each, in two successive weeks. Each selection was played three times consecutively in the first hour, and twice consecutively in the second hour. It was thought that in this way a total of five presentations would provide familiarity without surfeit. For half the *O*s, the order of presentation was: Schoenberg (S) S S, Hindemith (H) H H — H H S S, and for the other half: H H H S S S — S S H H, to equalize contrast and fatigue effects.

E. read the following instructions to each *O*, and took great care throughout the experiment to express no opinions of her own about the music. She also charged each *O* to say nothing about the experiment to any one.

> I shall play two selections from the music of two representative contemporary composers to see whether you like them more, less, or just the same, after hearing them a number of times. You will hear each one three times now, and again two times at the next session. As I play each time, raise your hand *at once* if you hear a part you *like more*, or *dislike less*, than the rest of the piece; and lower your hand *at once* when that part is no longer especially pleasant or unpleasant. Note why you chose these parts so that you can report your reasons afterward. If no part is outstanding, do not raise your hand. At the end of the first and last presentations, I shall ask you to say why you raised your hand when you did; and also to estimate how much you liked or disliked the music as a whole, using a scale ranging from —3

> to +3, i.e., —3 if you dislike it very much; —2 dislike it moderately; —1 dislike it a little; 0, are indifferent; +1, like it a little; +2, like it moderately; +3, like it very much. So far as this study is concerned, there is no right or wrong answer. It is just your own honest opinion that is wanted.

A stop watch was started with the first note of the recording, and the times of hand raisings and lowerings were noted so that they could be referred later to the music scores, which had been correspondingly marked in seconds.

B. Results

Both selections gained in general affectivity of response. In the first hearing, the average rating for *S* was —.50; in the last hearing, +.22. For *H* the corresponding figures are +.53 and +1.15. Table 1 shows the estimates of the individual *O*s.

TABLE 1
Amount of Affectivity of Response

0	Schoenberg First hearing	Schoenberg Last hearing	Hindemith First hearing	Hindemith Last hearing
1	0	+2	+2	+2
2	—1	—1	0	+1
3	—2.5	—2	—1	—1
4	—1	—1	—1	+1
5	—1	0	+1	+2
6	0	+1	+1	0
7	—2	0	—1	+1
8	0	+1	+1	+1.5
9	0	+1	+1.5	+2
10	+ .5	— .5	+1	+1
11	+1	+1	+1	—1
12	+1	+2	+3	+3
13	—1	0	+1	+2
14	—2	0	—1	+1
15	+1	+1	—1	+2
16	—1	+1	+1	+1

The table shows, besides the variety of estimates, that 8 *O*s positively liked *S* in the last hearing, as against 4 in the first; corresponding figures for *H* are 10 and 3. In the case of 5 *O*s, an initial dislike was changed to a final liking.

The average number of seconds "liked better" or "disliked less" also increased from first to last hearings: 14 per cent for *S*, 16 per cent for *H*. These figures were found by dividing the increase in number of seconds preferred, for each *O*, by the total number of seconds in the recording, and averaging the results of all *O*s.

Were there any regions generally preferred by the *O*s? As each section of the recording had a total of 80 chances of being preferred (by 16 *O*s in 5 hearings), any section with a score of 40 or more was considered to be generally popular. One such region was found in *S*; 5 in *H*. Regions of low preference were considered to be those each second of which had a score of 10 or less. On this basis, 5 such regions were found in *S*; 3 in *H*.

It is pertinent to inquire also how consistently the *O*s chose their own regions of preference. If we take as our criterion of consistency, the preferring of a region in four of the five hearings (thus requiring preference to hold over from one week to the next), we find the following number of separate areas in which each *O* showed consistency; and her percentage of consistency of choice may also be found by dividing the number of sections of the *O*'s consistent preferences by the total number of sections of all her preferences (Table 2).

TABLE 2

	S		H	
0	No. of areas consistently preferred	% Consistent	No. of areas consistently preferred	% Consistent
1	1	14	2	40
2	7	76	8	80
3	0	0	5	90
4	4	14	4	37
5	3	19	1	31
6	9	55	7	65
7	0	0	0	0
8	0	0	0	0
9	0	0	6	28
10	2	23	7	65
11	1	11	6	39
12	0	0	2	50
13	8	37	5	50
14	8	49	6	34
15	8	43	4	42
16	7	26	10	44
Av.	3.6	24	4.6	43

These figures, like those of Table 1, show considerable variety, but also some consistency on the part of most *O*s, and an av.% consistency almost twice as great for *H* as for *S*, though the number of consistent areas does not greatly differ for the two composers; an explanation of this will be suggested later.

We see, then, that there are generally popular and generally unpopular areas in both composers, and that there is considerable consistency in preferences. What, now, are the popular and unpopular regions, what are their actual characteristics, and what reasons were alleged for their popularity?

The one generally liked region in *S* is from Measure 139 to 143 inclusive, in the general section of quasi-development. This region had 41 votes and was consistently liked by 8 of the 16 *O*s. It is a rather quiet, wistful passage, with short degree-wise melodies successively played by three of the instruments, with only the second violin maintaining the disjointed accompaniment-figure that characterizes the whole movement. The reasons alleged for all *S* preferences, in order of frequency, are: rhythm and tone quality (equal in frequency); less dissonance and structure (equal); melody; expressiveness; familiarity; simplicity. The popular measures noted above have degree-wise melody, are less dissonant; and are relatively simple. Tone quality comes out well, also, in these passages, as the instruments can easily be heard individually.

The popular regions in *H* are, in order of time: Measures 38 and 39 (43 votes, consistently liked by 11 *O*s). This is a degree-wise melody played an octave apart by the first violin and viola, with simple accompaniment by the other two instruments just at the end.

Measure 48 (64 votes, consistently preferred by 13 *O*s): a long, slow viola solo, playing a diatonic melody somewhat reminiscent of the opening theme, and marked "sehr ruhig." This is much the most popular of all preferred regions.

Last part of Measure 51 (49 votes, consistently preferred by 10 *O*s): wholly a cello solo, with slow degree-wise melody.

Measures 71-73 inclusive (50 votes, consistently preferred by 9 *O*s): a melody almost wholly degree-wise, for violin solo.

Measures 78-80 inclusive (42 votes, consistently preferred by 12 *O*s): violin and cello play here a degree-wise melody an octave apart, with the introduction in Measure 79, of the other instruments playing softly in dissonance.

The reasons alleged for all *H* preferences, in order of frequency, are: melody, less dissonance, tone quality, structure, simplicity, tone color, rhythm, dissonance, expressiveness. It may be seen from the above descriptions of the preferred regions, that melody, less dissonance, tone quality, and simplicity especially fit these passages.

Most of the reasons alleged for preference are common to *S* and *H*, though the order is different as is to be expected from the different nature of the compositions. Dissonance, however, has occasional positive value in *H*, but not in *S*. Familiarity, not a specifically musical factor, is occasionally mentioned in *S*, but not in *H*. Tone color, mentioned in *H*, is never mentioned in *S*. Combining the frequency orders of alleged reasons for preferences in the two compositions, the most frequently mentioned factors are tone quality, less dissonance, and melody. Only the last two of these are features of the compositions themselves.

Something may also, perhaps, be learned from a brief examination of the least popular regions. These are in *S*: Measures 70-77 inc.; 59-166 inc.; 273-278 inc.; 298-307; 311-end. These passages, as indeed many others, too, are all complex and dissonant, with all four voices playing most of the time, chiefly in large melodic skips dictated by the tone row.

In *H*, the least popular regions are: Measures 41-42 inc.; 46 (last part), 47, and 48 (first part); 74-77 inc. The first two of these areas are dissonant chords; the last area has a fragment of melody, repeated, to the rhythmic and dissonant accompaniment of the three other instruments.

Explanation of the preferences and consistencies which we noted in Table 2, may now be attempted on the basis of the following considerations. Take first the fact that, though both of the works studied are polyphonic and dissonant, and are not tonal in the classic sense, they are nevertheless quite different in effect, one important reason for the difference being the prominence of degree-wise melody in *H*, and its almost total absence in *S*, where large melodic skips are characteristic. Another reason for the difference is tonality, such as it is, in *H*, and its absence in *S*. Now melody accounts almost entirely for preferences in *H*; and it seems likely that it is largely a proneness to attend to, and to like, such melody that explains the greater consistency of preference found here. When such melody is missing, attention goes to less compelling features, differing for different *O*s, and even for the same *O* at different times. In *S*, diatonic melody is rare, and as unresolved dissonance was not liked, and as consonant harmony is seldom present, attention was probably given to one or another of the less compelling horizontal aspects of the music, any one of which might have been singled out at one time, and not at another time, with resulting inconstancy of preference. Voluntary remarks by some of the *O*s to the effect that the unpleasantness of the dissonances in *S* made them ignore the vertical dimension and turn their attention instead to some other aspect of the music, support this idea.

C. Conclusions

1. Familiarity with the serious modern music here investigated usually increases enjoyment of it.

2. An initial dislike of this music may, with repeated hearing, become a liking for it.

3. There is some general agreement as to what areas are preferred.

4. There is considerable consistency of preference on the part of the individual *O*s, indicating the validity of the preference.

5. The generally popular areas are relatively simple and melodious in the classic sense, the outstanding example being the almost universally and consistently preferred long solo melody in Hindemith.

6. Melody and less dissonance are frequently alleged as reasons for preference. The music scores show that these qualities are actually characteristic of the popular areas.

7. Absence of degree-wise melody and of consonant harmony may in these instances account largely for inconsistencies of preference, other aspects of dissonant polyphonic music simultaneously present compelling attention less forcefully, and therefore competing among themselves on terms of approximate equality, with a consequent variety of results, and a resulting inconstancy of preference.

8. Neither of the compositions studied was generally much liked, even at the end of the familiarizing process.

D. Discussion

Perhaps it is too great an assumption to suppose that the results of this study of only two examples of modern music have relevance for any other music. But it is tempting to try to apply them more generally. One must, of course, agree with those who think any serious music should be given careful consideration. Richards (1) makes the same plea for poetry, believing that a real appreciation of poetry is not beyond the power of many of us if we train and try for it, since "there is no gap between our everyday emotional life and the material of poetry." The same may be said, I think, of the material of music. If we are equipped with musical sensitivity, training, and a zeal for understanding and appreciating, music which is authentic should touch off rewarding responses. The results of this study for which the participants were surely fairly well equipped, suggest that there is little intrinsic virtue in a complete departure from the traditional forms of melody and harmony. Response to such melody which is largely step-wise and flowing is easy, natural, and pleasant, as is also response to harmony, which lies in the natural order of the world of sound based, as it is, on the chord of nature. Traditional tonality, not directly treated here, but actually somewhat involved because of its greatly modified use in Hindemith and its total absence in Schoenberg, brings about in the most effective way yet known to music, a sense of direction, by reason of the departure and return of its melody and harmony to the home key, with the consequent feelings of tension and release, which are among the basic satisfactions not only in music, but in all of life. There would seem to be good reason, so far as the aesthetics of music goes, for a composer's *including*, at least, some of the basic features of traditional music.

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THE RELATIONSHIP BETWEEN THE *F* SCALE AND APHORISM USAGE AND AGREEMENT*

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A. THE PROBLEM

The California *F* (Fascism) Scale was not constructed in a strictly empirical fashion. "For every item there was a hypothesis, sometimes several hypotheses, stating what might be the nature of its connection with prejudice" (1, p. 225). Although refinement of the scale was based on an item analysis, it has been pointed out (4) that if the discriminating power of an item and its support of the theory were at variance, the decision was made to retain items which correlated highly with anti-Semitism even though they were poor measures of *F*. There "are no less than seven decisions, in a 19-item scale, each of which enhances the predictive value of the scale, but simultaneously renders it misleading as a test of the theory" (4, p. 76). Thus it is apparent that the content of the items was deemed to be so important that if items strongly supported the theory they were in several instances included in the scale even though they were relatively nondiscriminating so far as *F* was concerned.[2]

The present study shows that the *form* as well as the *content* of the items is an important factor in determining response. Cronbach has pointed out (3) that personality variables and response sets may be closely related, and that response set is valid to the extent that the variance attributable to it is common to the test criterion. Where a measure is designed to tap the underlying personality structure of the potentially fascistic individual, it would seem that variance due to the manner in which the items and response categories are presented should be taken into account. Support for this suggestion is found in a recent study by Leavitt, Hax, and Roche (5), who

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[1] This article is based on research undertaken at the Center for Advanced Study in the Behavioral Sciences, 1954-55. The writers are grateful for valuable comments and suggestions contributed by 1954-55 Center Fellows.

[2] It should be pointed out that the majority of the items which had the greatest discriminating power were also the items which tended to support the theory, but the exceptions noted above indicate the degree to which emphasis was placed on the content of an item.

found that when the form of the F-scale items was changed by rewriting half of them so that *disagreement* would indicate an authoritarian attitude, correlations between scores on the reversed and unreversed halves remained positive for the originally low F group, but became negative or low positive for the originally high F group. Other studies (2, 6) have presented additional evidence which shows the importance of taking into account the tendency to respond on the basis of the structure as well as the content of personality test items.

B. METHOD

Two aphorism scales were constructed. The first scale (Aph_1) consisted of 51 statements which were classified as either positive or negative on the basis of the joint rating of three judges. A positive statement was defined as one affirming a value consistent with or based on Christian, humanist, or democratic ethics or ideals, while a negative statement was one that denied these values. "It doesn't matter whether you win or lose, but how you play the game" is an example of a positive item; "nice guys finish last" is an example of a negative item. The Aph_1 scale was then administered to 89 college students in an elementary economics course and to 14 carpenters working on a local construction project. They were asked to rate each aphorism according to the extent to which they heard others use the expression, the extent to which they used the expression themselves, and the extent to which they agreed with the aphorism. Frequency of usage was indicated by the categories *frequently, occasionally, rarely, never*, with scores ranging from 4 to 1 assigned to each category, respectively. Agreement with aphorisms was indicated by the categories *strongly agree, agree, uncertain, disagree, strongly disagree,* with scores ranging from 5 to 1 assigned to each category, respectively. The F scale was also administered to the students and carpenters,[3] the response categories and values being the same as those used to indicate agreement with aphorisms.

Because of the length of the Aph_1 scale and a desire to increase the reliability of the positive-negative classification, a second aphorism scale was constructed. First, positive or negative ratings of 95 aphorisms were obtained from seven judges, working independently. Then, from these items were selected 34 items (17 positive and 17 negative) which had been placed in the same category by at least five out of the seven judges. The 34-item scale (Aph_2) and the F scale were subsequently administered to 62 members of a women's service club and 40 members of a men's service organization.

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[3] The item "Familiarity breeds contempt" was omitted from the F scale since it appeared in the aphorism scale.

C. Results

The product-moment *r*'s between the *F*-scale scores and aphorism usage and agreement scores are shown in Table 1.[4] Because *r*'s between usage by others and self usage were above .90, only *r*'s between *F* scale and self usage are reported.

TABLE 1

CORRELATIONS BETWEEN *F* SCALE AND APHORISM USAGE AND AGREEMENT

	N	*F* scale and positive aphorisms *r*	*F* scale and negative aphorisms *r*
Self usage			
Students	89	.14	.09
Carpenters	14	.53*	.46
Service club women	62	.27*	.25*
Service club men	40	.46**	.44**
Agreement			
Students	89	.34**	.24*
Carpenters	14	.40	—.04
Service club women	62	.38**	.32**
Service club men	40	.57**	.46**

Note.—Correlations for the students and carpenters are based on the Aph_1 scale of 21 positive and 30 negative items, while correlations for the service club men and women are based on the Aph_2 scale of 17 positive and 17 negative items.

*Significant at the .05 level.

**Significant at the .01 level.

Inspection of Table 1 indicates that with one exception the relationships are positive. Eleven out of the 16 *r*'s are at the 5 per cent level of significance or better. That is, those *S*s who are high on the *F* scale tend to use and to agree with aphorisms regardless of the positive or negative values contained within the aphorism. In fact, the *r*'s between the *F* scale and positive aphorisms are all higher than those between the *F* scale and negative aphorisms.

The reader may have noted that in this study the response categories used for the *F* scale included an *uncertain* category, which was omitted in the original scale because the authors felt that greater discrimination would result if an "escape" response was not permitted. On this basis one could conjecture that without the neutral point *r*'s in this study might be somewhat larger.

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[4] The means and standard deviations have been omitted due to differences in number of items and response categories. These data may be obtained from the writers if desired.

D. CONCLUSIONS

This study is one of several (2, 5, 6) which support the view that the *F* scale is measuring both agreement with antidemocratic ideas and agreement with the *manner* in which the ideas are presented. That is, *S*s high on the *F* scale tend to agree with democratic, humanist values provided they are presented in the authoritative, dogmatic form of an aphorism. Not only do they agree with democratic values so presented, but the agreement tends to be even greater than it is for nondemocratic values.

The results of this study are compatible with the theory of the antidemocratic personality, however, in the sense that its authors emphasize the important rôle of conventionality in the authoritation syndrome (despite the fact that the conventionality items as a group had the lowest discriminatory power of any of the groups). Thus another way of interpreting the present findings is that the more authoritarian *S*s use and agree with aphorisms because they are popular, conventionalized sayings. The desire to endorse a maxim felt to be accepted by other members of the group may have outweighed the attitude toward the values expressed in the statements. In this respect attention is again drawn to the high *r* between rated usage by others and usage by self.

While the results of the present study are not necessarily inconsistent with the authoritarian personality concept, they do provide a basis for questioning the extent to which items in the *F* scale considered individually support the hypotheses underlying them, and the meaningfulness of a qualitative analysis of individual item responses as in the case studies of Mack and Larry (1). Our results also provide a possible explanation for endorsement of seemingly contradictory statements such as those found in the related scale of anti-Semitism (*A-S*).

E. SUMMARY

Considerable attention has been paid to the *content* of the *F* scale and to the extent to which the scores validate the hypotheses on which the items were based. In this study attention was drawn to the *form* of the items in the *F* scale and a question was raised concerning the degree to which the *F*-scale results actually confirm the hypotheses underlying the development of the scale.

Aphorisms were classified according to their affirmation or denial of values consistent with or based on democratic ethics or ideals. Four groups of *S*s then rated each aphorism according to the extent to which they heard others

use the expression, the extent to which they used it themselves, and the extent to which they agreed with the statement. *S*s were also asked to complete the *F* scale. Correlations between *F*-scale scores and aphorism usage and agreement scores were high and positive for both types of aphorisms, those confirming and those denying democratic ideals.

The conclusion drawn was that the *F* scale may well be measuring agreement with values expressed in an authoritarian manner, a common feature of both the aphorisms and the *F* scale. These values may or may not be consistent with an antidemocratic attitude.

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PERFORMANCE IN FOLLOWING TRACKING AS A FUNCTION OF THE SENSITIVITY OF THE AIRPLANE-TYPE CONTROL STICK*[1]

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A. INTRODUCTION

What basis is there for predicting how tracking performance will vary as a function of the sensitivity of an airplane-type control stick? Numerous experiments have yielded data which bear indirectly on this problem. Studies of the accuracy of linear positioning movements (2, 14, 15) have shown that relative constant error and variability decrease with the distance to be moved. When velocity control was achieved in compensatory tracking by a free-moving stick, lower values of sensitivity led to better performance (7). Both compensatory and following tracking scores were higher when a greater range of movement was required for a horizontal control lever (4, 11). A stick control requiring movement of considerable amplitude seems to be called for by the findings cited, but the question is seen not so easily resolved in the light of the finding that an isometric (pressure-type) stick led to better performance than did a free-moving stick for rate control in a compensatory tracking task (7).

Studies of tracking and target acquisition with rotary controls (cranks and knobs) tend also to suggest the superiority of low sensitivity, but not unequivocally. Direct (positional) tracking has been shown to be best when handwheels of low sensitivity (requiring high rates of cranking) have been provided (5, 8, 13). This finding, however, does not hold for handwheel controls when considerable amounts of acceleration and slewing are demanded (1) or when tracking is of the rate-aided type (6, 12). The gearing of a rotary control to an indicator should provide a low sensitivity for purposes of adequate final adjustment, but where considerable travel is required before the region of final setting is reached, a higher sensitivity is demanded so that travel time will not be excessive (9, 10).

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[1] The experiment reported here is part of a research program in perceptual-motor factors affecting tracking performance, carried out under Contract Nonr 668-10 between the Office of Naval Research and the University of Rochester, with S.D.S. Spragg as Responsible Investigator.

The differences between compensatory and following tracking, between rotary and lever controls, etc., are all great enough as to preclude a confident prediction as to how different sensitivities of control stick will affect performance on a following tracking task. The present study seeks an empirical answer to this question. Also to be determined are the transfer effects that result when control sensitivity is changed.

B. Subjects

The *S*s were 64 college students who had not previously participated in a tracking experiment.

C. Apparatus

The Rochester Generalized Tracking Apparatus, described elsewhere (3), was employed. The target to be tracked was a moving spot, optically projected on a 35" diameter screen together with a circle which served as the target follower. The apparatus was set to provide positional control of the follower as the stick was moved. Target courses of irregular pattern were provided from a magnetic program tape. A shutter interrupted the optical projection at the end of each trial. Two electronically defined scoring zones were employed to obtain two time-on-target scores cumulated simultaneously on two Standard Electric timers. The sizes of the scoring zones, target, follower circle, and display screen are given in Table 1.

TABLE 1
SIZES OF DISPLAY ELEMENTS AND SCORING ZONES

Display or scoring zone	Size in inches	Included visual angle
Screen	34.5" diam.	29° 1'
Target	0.9" diam.	46"
Follower circle	1.8" diam.	1° 34'
Tight scoring zone	1.8" square	1° 34'
Loose scoring zone	4.0" square	3° 26'

The control was an airplane stick assembly modified to provide spring centering and fitted with potentiomenters so as to position the follower circle on the screen at a position corresponding to the location of the stick. Moving the stick left or right moved the follower correspondingly left or right; moving the stick forward made the follower move upward on the screen; pulling back on the stick moved the follower circle downward. The different display-control movement ratios or stick sensitivities represented different amplifications in the control circuit.

D. PROCEDURE

*S*s were required to perform a following tracking task using the airplane stick control. Three different values of stick sensitivity were employed. Expressed as ratios of display movement to control movement, they are presented in Table 2.

*S*s were randomly assigned to eight groups which differed as to sensitivity of the control employed and the level of training administered before the sensitivity was changed to a higher or lower ratio. The plan of the experiment is given in Table 3.

TABLE 2
DISPLAY-CONTROL MOVEMENT RATIOS

Sensitivity	Display-control Movement ratio	Movement of follower per 1° of stick movement
Low	1:1	0.5″
Medium	4:1	2.0″
High	16:1	8.0″

TABLE 3
PLAN OF EXPERIMENT

Group	Initial training	Subsequent performance
A	16 trials on 1:1 ratio	16 trials on 16:1 ratio
B	16 trials on 4:1 ratio	16 trials on 1:1 ratio
C	16 trials on 4:1 ratio	16 trials on 16:1 ratio
D	16 trials on 16:1 ratio	16 trials on 1:1 ratio
E	48 trials on 1:1 ratio	16 trials on 16:1 ratio
F	48 trials on 4:1 ratio	16 trials on 1:1 ratio
G	48 trials on 4:1 ratio	16 trials on 16:1 ratio
H	48 trials on 16:1 ratio	16 trials on 1:1 ratio

Each trial began when the shutter opened showing the target at the center of the screen. It remained stationary for about three seconds, then moved at moderate speed through a looping or zigzagging course for about 20 seconds. The shutter then closed, ending the trial, the screen remaining dark for the intertrial interval of seven seconds.

Instructions to *S* included a brief demonstration by *E* of directional relationships between movements of the stick and corresponding movements of the target follower circle. *S* was permitted no practice prior to the first trial. *S* was told to get the follower circle around the target as quickly as possible when it appeared and to keep it on the target as much as possible during each trial. A two-minute rest was given just before the final 16 trials; Groups *E-H* also had a one-minute rest after Trial 16 and Trial 32 of initial training.

Time-on-target scores were simultaneously cumulated on two Standard Electric timers, which corresponded to two different scoring tolerances or zones as indicated in Table 1. For the tight tolerance the target had to extend at least halfway into the follower circle to be scored as on target. This tolerance was somewhat more liberal than *S* might infer from the instructions which said to keep the follower circle around the target. A loose scoring tolerance was even more liberal, the second timer scoring even when the target was just outside the follower circle.

E. Results

For purposes of analysis, the data within successive blocks of four trials were combined. Graphs of the means of the tight tolerance scores are presented in Figure 1. To provide performance curves that are as reliable as possible, data from groups given identical treatment through all or part of

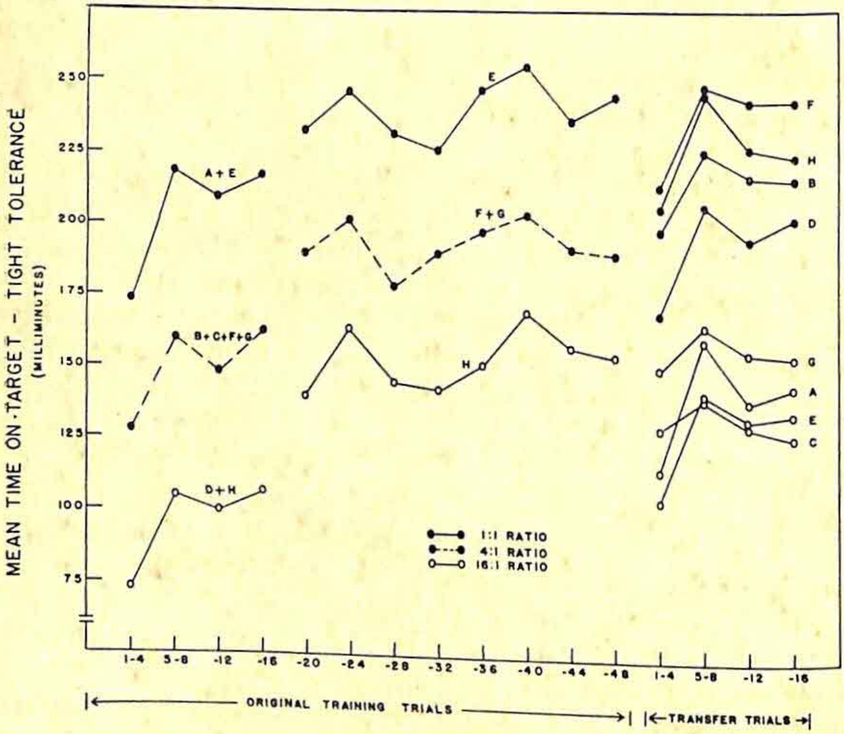

FIGURE 1
Mean Time on Target Achieved With Each Sensitivity Ratio on Original Training Trials and Transfer Trials

Data are combined for blocks of four trials and pooled for lettered groups which had experienced identical treatment. $N = 8$ in each lettered group.

original practice were pooled. Thus, three curves, one for each display-control movement ratio, are shown in the figure for Trials 1-16. These pooled data for the 1:1 ratio and the 16:1 ratio were used in assessing transfer effects, discussed below. For that purpose the designations Group *A* plus *E* and Group *D* plus *H*, respectively, are employed. Other data are shown in Figure 1 to have been pooled, but these did not enter into the assessment of transfer effects. For the transfer trials themselves, data are plotted for each of the eight groups. A graph of the loose tolerance scores would look very similar to that shown for the tight tolerance. Since tight and loose tolerance results were essentially comparable, only tight tolerance results will be reported.

1. *Performance Level Attained at End of Original Training*

To assess the effects of amount of original training and of stick sensitivity upon performance, the time on target scores summed over the last four original training trials were subjected to an analysis of variance. Data obtained from the groups trained originally on the 4:1 ratio were combined within amount of training. The level of performance achieved at the end of original training by the groups having the long training series (48 trials) was significantly greater ($F = 19.09$; $df = 1, 58$) than that achieved by the groups having the short training series (16 trials). The differences attributable to stick sensitivity were also significant ($F = 38.80$; $df = 2, 58$), with performance being better when a low sensitivity was used. The interaction between length of training series and sensitivity was non-significant, indicating that the dependence of performance on sensitivity was similar for both amounts of training.

2. *Mean Performance Level During Original Training*

Since the performance curves for the training trials (Figure 1) indicated that the three control sensitivities led to different levels from the very beginning of practice, two additional analyses of variance were made of the data summed across all original practice trials. For the groups given the short training session(*A*, *B* plus *C*, *D*) the analysis showed sensitivity to be significant ($F = 33.37$, $df = 2, 29$). For the groups given 48 original practice trials (*E*, *F* plus *G*, *H*), sensitivity was similarly significant ($F = 16.33$; $df = 2, 29$). Mean time on target scores for all original training trials combined are shown in Figure 2 as a function of stick sensitivity. The relative superiority of the low sensitivity ratios is clearly indicated, as is the beneficial effect of additional practice, especially for the high (16:1) ratio.

3. *Change in Performance Level at Change in Sensitivity Ratio*

The absolute level of performance of all groups changed significantly when they were changed from one sensitivity ratio to another. The direction of change in scores was determined by the change in sensitivity with scores increasing when the sensitivity became lower and decreasing when the sensitivity became higher.

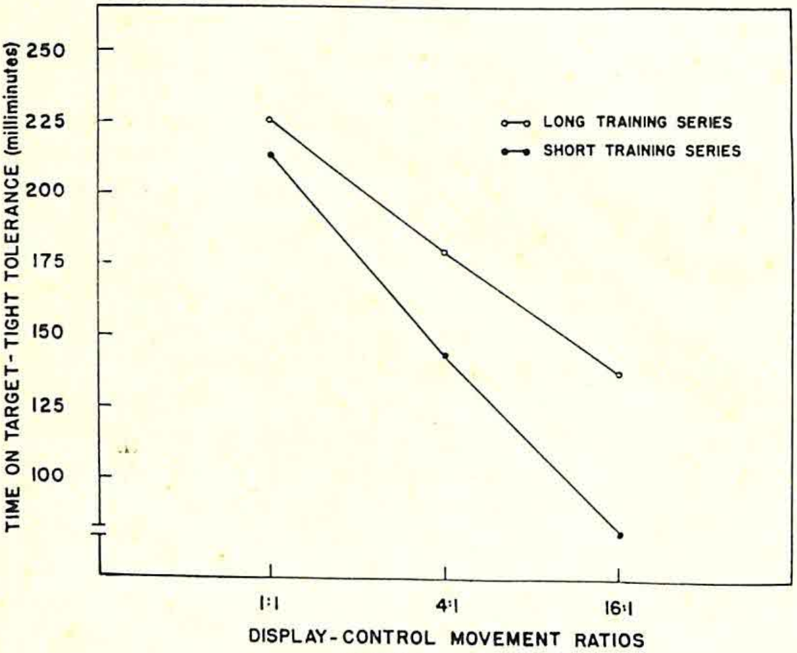

FIGURE 2

Mean Time on Target for All Original Training Trials as a Function of Display-Control Sensitivity Ratio With Length of Original Training as Parameter

4. *Immediate Transfer Effects between Sensitivity Ratios*

To assess the significance of immediate transfer effects from practice on higher sensitivity ratios, performance with the low (1:1) sensitivity on the first block of trials after transfer of Groups *B*, *D*, *F*, and *H* was compared with the first block of training trial scores of Group *A* plus *E*. To evaluate immediate transfer from lower sensitivities to the highest (16:1), initial transfer performance of Groups *A*, *C*, *E*, and *G* was compared with the initial training performances of Group *D* plus *H* (see Figure 1). In all four instances immediate transfer from lower sensitivities to 16:1 (Groups *A*, *C*, *E*, *G*) was significant, based on the 5 per cent level of confidence, while in no instance was there statistically significant transfer from either higher sensitivity to the lowest (Groups *B*, *D*, *F*, *H*). (However, performances of Groups *F* and *H*, who had 48 training trials, were numerically higher than the initial training performance of Group *A* plus *E* and this difference might very well prove significant if greater precision were obtained by increasing *N*.)

Of the four groups that showed initial positive transfer when changed to the 16:1 ratio from lower sensitivities, Group *G* showed the greatest beneficial effect of previous practice on the 4:1 ratio. Transfer in this group can be considered as complete (100 per cent) since its initial transfer score was not significantly below that of Group *H* at the end of original training. In other words Group *G* performed as well on the 16:1 ratio after 48 trials on the 4:1 ratio as did a group which had practiced about the same amount previously on the 16:1 ratio. Groups *A*, *C*, and *E*, although showing positive initial transfer when compared to initial performance of Group *D* plus *H*, did not show complete transfer. The per cent transfer which these groups did exhibit was not calculated since the broad fiducial limits accompanying any estimate of the population parameters would render them of little value.

When initial transfer scores are compared, holding amount of original training constant, for groups that transferred from different ratios to the same ratio we find a superiority of Groups *B*, *C*, *F*, and *G* when compared with Groups *D*, *A*, *H*, and *E*, respectively. That is, the groups which made the change from the 4:1 ratio each did better than the corresponding group which was given a greater change in stick sensitivity, although these differences did not reach statistical significance. This suggests that the hypothesis that positive transfer is a function of stimulus and response similarity may be applicable to tracking where a change in display-control movement ratio constitutes the difference between tasks.

5. *Mean Performance Levels Attained Over All Transfer Trials*

As Figure 1 clearly shows, the performance levels of the eight groups during the transfer trials were separated into two clusters of four groups each with those transferring to the low (1:1) sensitivity performing better than those experiencing the higher sensitivity of the 16:1 ratio. Among the latter four groups (*A*, *C*, *E*, *G*) there were no statistically significant differences attributable to the ratio on which they had previously practiced or to the amount of original training. On the other hand, for the 1:1 ratio, the longer original training given to Groups *F* and *H* led to a higher level of performance over transfer trials (combined mean of 232.2 milliminutes) than that attained by Groups *B* and *D* (combined mean of 204.8 milliminutes, $F = 4.20$; $df = 1, 28$).

6. *Transfer Effects Over All Transfer Trials*

In general, statistical analyses based on all 16 transfer trials revealed about the same pattern of transfer effects as had appeared in the first block of four transfer trials. None of the groups which were changed to the 1:1 ratio showed a statistically significant transfer effect when compared to Trials 1-16 of Group *A* plus *E*. Partly responsible for this may be the high performance level attained by Group *A* plus *E* with the 1:1 ratio, such a low sensitivity apparently being quite facilitative. As the subsequent performance of Group *E* tends to show, there appears to be a performance plateau for this task which would make it very hard to demonstrate statistically a positive transfer effect. As a matter of fact, Groups *F* and *H* were not significantly lower in their overall transfer performance than was Group *E* on Trials 33-48. Thus transfer to the 1:1 ratio may be regarded as essentially complete for these groups even though, at the same time, statistical analysis does not permit us to reject the hypothesis that there was no positive transfer. Of the groups given less original training, Group *B*'s transfer performance was not significantly lower than that of Group *E* over Trials 17-32. Group *D*, however, was significantly below the same control value.

Groups *A*, *C*, *E*, and *G* all showed a positive transfer effect based on all 16 transfer trials when compared with Trials 1-16 of original training of Group *D* plus *H*. Statistical analysis showed further that the hypothesis is tenable that each of these groups showed complete (100 per cent) transfer. (Transfer scores of Groups *A* and *C* were not significantly different from original training scores of Group *H*, Trials 17-32; transfer scores of Groups *E* and *G* were not significantly different from original training scores of Group *H*, Trials 33-48, where the performance curve of Group *H* was assumed to be at or near a plateau.)

F. Discussion and Summary

The results of this study are clear in showing that following tracking performance depends upon the sensitivity of the stick control provided for the operator. Men make higher scores when the control is of low sensitivity, requiring fairly large excursions of the stick to follow the target. The superiority of the less sensitive control probably stems from the greater relative precision of control over the target follower that is afforded the operator. This greater relative precision has been demonstrated for the longer discrete motions in kinesthetically-guided positioning tasks in several studies (2, 14, 15). Further explaining the higher time on target scores with lower sensitivity values is the fact that inadvertent motion by the operator ("noise" in the control output) is less likely to send the follower outside the scoring zone when a low sensitivity is used than when follower motions are given greater amplification as in the higher sensitivities. The greater stick excursions demanded with lower sensitivities are not more time consuming to a detrimental degree since the longer movements tend to be executed at a higher rate of speed. Thus, lower sensitivities of stick control yield higher precision of tracking without imposing a time penalty on the operator. It would appear that the design of stick controls should provide for as much excursion as is compatible with other considerations such as the operator's reach, strength, and restriction by clothing and equipment. (As was noted in the Introduction, a rotary control usually has an intermediate value of sensitivity as optimal which represents a compromise between speed of slewing and precision of adjustive movements.) Even after men had practiced extensively on some other ratio, control sensitivity was still found to be a key determinant of performance level during transfer trials. The change to a more sensitive ratio always resulted in an absolute decrement of performance. Conversely, a change to a less sensitive control always led to improvement. A conventional transfer analysis, comparing transfer performance with original training trials, showed that the four groups transferring to the lower sensitivity (1:1 ratio) did not do significantly better than Groups *A* and *E* which started with this low sensitivity. This fact, of course, does not negate the finding that the low sensitivity ratio yielded best performance during transfer trials as well as during original training. Transfer was shown to be positive in the groups that changed to a higher sensitivity. These positive transfer findings do not, of course, invalidate the more fundamental demonstration that a higher sensitivity ratio leads to poorer tracking performance with a stick control.

Since operators seem to perform well with a stick of low sensitivity, and do this without negative transfer effect even when they have been changed from a more sensitive control ratio, a question might be raised as to the utility of providing automatically changing display-control ratios so that the better low ratio is always in effect despite, for example, the airspeed of the aircraft which normally changes the control sensitivity as experienced by the pilot. Such a provision, however, might rob the pilot of useful cues. Therefore, such a suggestion as this must be offered only very tentatively. Attention should be paid to the data of the references cited as well as to necessary further research in determining design characteristics.

The reported superiority of an isometric stick to a free-moving stick for compensatory tracking with rate control (7) is seemingly at variance with the data of this study, providing the two tracking tasks are considered comparable. Further studies of the rôle of stick sensitivity in following and compensatory tracking, and in the positional and velocity types of control are needed to clarify remaining questions.

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SOME RELATIONSHIPS BETWEEN VERBAL BEHAVIOR OF THERAPIST AND PATIENT IN PSYCHOTHERAPY*[1]

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A. THE PROBLEM

The research reported in this paper represents one facet of a larger study which approaches the psychotherapy situation as an informational exchange system.

The conceptualization of the therapy situation as a communication system has become explicit in the work of Sullivan (11), Ruesch and Bateson (10), Grinker (4), Brosin (1), and others. Yet empirical studies deriving from this conceptualization have been sparse. Special mention should be made here of the work of Saslow (6-8) and his collaborators who have systematically studied therapist verbal behavior in relation to patient verbal behavior, utilizing Chapple's Interaction Recorder as the measurement device. Their studies, however, have been limited to the Initial Interview between therapist and patient. In the research presented here the relationship between given kinds of informational behavior on the part of the therapist and patient is specified over the whole of therapy.

While many aspects of long-range therapist and patient interaction are being studied, this preliminary report restricts itself to a discussion of the relationship between the amount of therapist speech (input) and the amount of patient speech (output). Data are available for four therapist-patient pairs, consisting of three verbatim transcripts of complete psychotherapies available in published form (Wolberg (12), Rogers (9), Deutsch (2)), and 12 continuous sessions of a therapy made available by Gill (3).

The coding units employed were printed or transcribed *lines* of continuous therapist speech (input) and printed or transcribed lines of continuous patient speech (output). Previous studies (5) of verbatim interview material have revealed a correlation of .8 between lines and meaningful propositions, a relation considered sufficient to permit substitution of the former measure for the latter.

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In order to emphasize the exploratory nature of specifying appropriate statistical techniques for this type of data, the various statistical analyses employed and the results obtained thereby are presented in the sequence of their application. It should be noted that the bulk of the statistical treatment of the data was based upon (*a*) selected non-parametric correlation models as well as on certain stabilizing transformations, and (*b*) various time-series methods of analysis.

B. STEPS IN THE ANALYSIS OF THE DATA

1. As an initial step Kendall Taus[3] were computed for the relationship between therapist verbal input and patient verbal output during each session. (The least number of sessions available for therapist-patient pairs was eight.)

TABLE 1
RANK ORDER CORRELATIONS (TAU'S) ON VERBAL INPUT-OUTPUT RELATIONSHIPS BETWEEN THERAPIST AND PATIENT FOR AN N OF 8 TO 12 SESSIONS

Therapist	Tau ($N = 8$ to 12)
Wolberg ($N = 9$)	.44*
Deutsch ($N = 12$)	.00
Rogers ($N = 8$)	—.07
Gill ($N = 12$)	.03

*Significant at the .10 level.

These correlations are summarized in Table 1. Table 1 indicates that when the session is used as the unit of analysis there appears a relationship between verbal input and verbal output for *only one* of the therapist-patient pairs. For three of the therapist-patient pairs there appears to be no relationship whatever.

However, it should be noted that though the decision to use the session as the unit of analysis was logical as a first step it was arbitrary. Relationships between therapist and patient verbal behavior, if present, may occur for considerably shorter or longer intervals.

2. Following the above-mentioned analysis each therapeutic session was divided into comparable categories ranging from eight to 12 divisions. This procedure allows for the most judicious use of correlational techniques. Table 2 summarizes the intra-session input-output correlations for each of three therapists.[4]

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[3] Certain other types of correlation methods were applied (Phi-coefficient, tetrachoric *r*, and Spearman's rho), but ultimately rejected because the data do not provide adequate criteria for their application.

[4] Intra-session input-output correlations were not computed for the Deutsch data.

Comparing correlations shown for Gill in Tables 1 and 2, we observe that while there is almost *no* relationship between therapist and patient verbal behaviour when the session as a whole is employed as the unit of analysis, *four* out of the *eight intra-session* input-output correlations appear valid. It seems then that the analysis of the data in terms of the session taken as a whole obscures relationships apparently present. Significant intra-session correlations are both positive and negative.

TABLE 2
RANK ORDER CORRELATIONS (TAU'S) ON VERBAL INPUT-OUTPUT RELATIONSHIPS BETWEEN THERAPIST AND PATIENT, PER THERAPEUTIC SESSION OBSERVED OVER TIME

	Correlation for each session								
Therapist	1	2	3	4	5	6	7	8	9
Wolberg	.05	—.57*	+.64*	—.18	.44†	—.10	.06	.33	—.02
Rogers	.22	—.16	—.24	—.14	—.43	.71*	.00	—.20	
Gill	.20		.43*	—.11	—.71**	—.27	—.38*	—.62**	—.07

†Significant at the .10 level.
*Significant at the .05 level.
**Significant at the .01 level.

3. To explore the nature of the intra-session relationships involved further, a time series was plotted using degree of correlation as the Y variable and the time order of the therapy sessions as the X variable (Figure 1).

The time series graphs shown in Figure 1 appear to indicate for all three of the therapists a cyclical type series of input-output fluctuations over time. No attempt is made in this descriptive report to speculate on the nature of the equilibrium processes involved.

4. From these Times Series curves, estimations were made of the "trend" of a particular series, as shown in Figure 2. Trend is defined here as the linear relationship—over time— of the verbal input-output correlation between therapist and patient. Based on this rather limited indication of trend, the data in Figure 2 suggest that a somewhat "typical" trend movement might be assumed for each therapist-patient verbal interaction system.[5]

C. HYPOTHESES AND IMPLICATIONS

Since the results of this exploratory investigation were based upon a relatively small number of cases (although a considerable amount of data was processed for the variable studied) the conclusions drawn are stated in the form of hypotheses for further testing. The following hypotheses appear warranted:

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[5] Although "trend" is often defined as the long-term movement found in a system or series, "long" in this connection is a relative term, and what appears to be long for one purpose may be short for another. In speaking of "trend," therefore, one should bear in mind the length of the series to which it applies.

1. (*a*) A given therapist-patient pair exhibit a "characteristic" pattern of verbal input-output relationships over time.

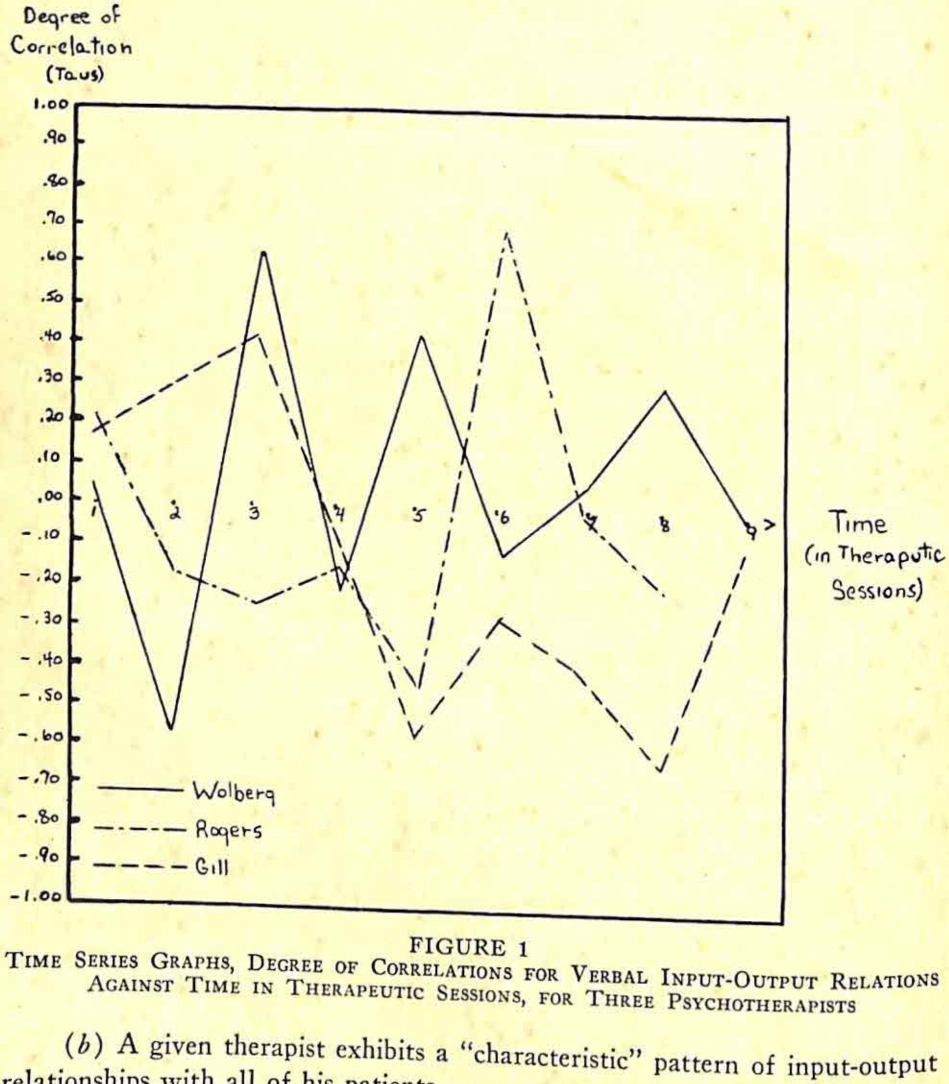

FIGURE 1
TIME SERIES GRAPHS, DEGREE OF CORRELATIONS FOR VERBAL INPUT-OUTPUT RELATIONS AGAINST TIME IN THERAPEUTIC SESSIONS, FOR THREE PSYCHOTHERAPISTS

(*b*) A given therapist exhibits a "characteristic" pattern of input-output relationships with all of his patients.

2. A time series (degree of intra-session input-output correlation by number of therapy sessions) of verbal input-output interaction for therapists of

different theoretical orientations is characterized by a cyclical type (or oscillation type) series of fluctuations.

3. A "typical" trend or "long term" movement can be observed in the patterning of therapist-patient verbal behaviour during psychotherapy.

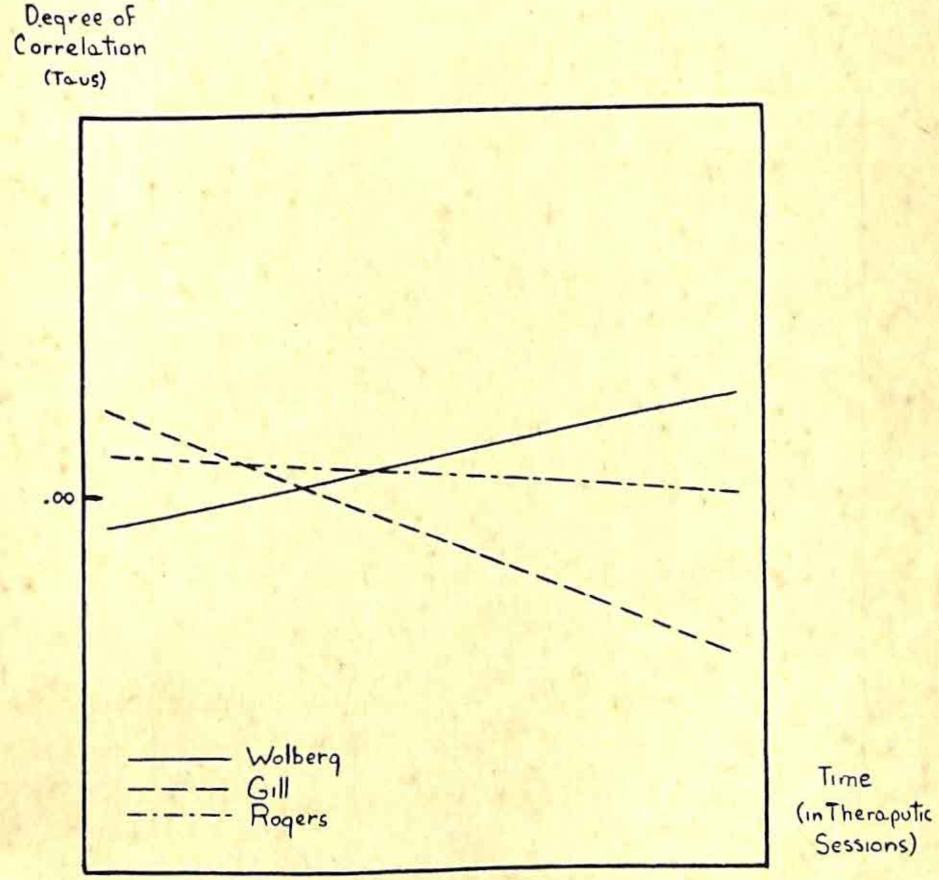

FIGURE 2

TREND LINE OF VERBAL INPUT-OUTPUT RELATIONSHIPS OVER TIME (BASED ON TIME SERIES GRAPHS OF FIGURE 1)

To assess the above stated hypotheses additional data will need to be processed (especially data on long term therapies). However, further study of the available data along the following lines is also indicated:

1. Additional analyses should be undertaken using intervals other than

those reported on in this paper. As has been said before, both the choice of the session, or of one-eighth of a session, as the unit for correlational analysis was a purely arbitrary one. The choice of smaller or larger units might well improve the correlational picture.

2. Further time series analyses are suggested consisting of: (*a*) the elimination of "irregular" or "random" aspects of the interaction through the use of moving totals and averages, a procedure undertaken in only a preliminary way in certain series up to the present; and (*b*) the intensive investigation of oscillation-type movements about the trend into "seasonal" as well as "cyclical" effects.

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[6] We want to express our gratitude to Dr. Gill for making these transcripts available to us.

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BRIGHTNESS ENHANCEMENT AND THE STIMULUS CYCLE*

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A. THE PROBLEM

It has been demonstrated in recent years that intermittent photic impingements on the retina may be more effective in producing brightness than continuous impingements of the same intensity (1, 2, 3, 4, 5, 11, 13). This occurs when the pulse rate is below fusion, pulses being defined here as the separate brief stimuli in the intermittent train. It has long been known that, at the fusion point (critical flicker frequency) and above, intermittent stimulation is *less* effective than steady. The result is known as the Talbot effect. When intermittent stimulation is more effective than steady, the result is called *brightness enhancement*. There is a range of effectiveness that lies between the Talbot effect and brightness enhancement which we shall call the *intermediate range*.

Bartley (1) showed that under some conditions, intermittent stimulation may fall even below the expected Talbot effect. This is the case when low intensity levels of impingement are used, with the intermittent field and the steady comparison field concentric rather than side by side. Hence, at subfusional pulse frequencies, photic impingement on the retina may either be much more or much less effective than the range producing steady brightness.

In one of the original papers, Bartley (1) indicated that brightness enhancement was dependent for its value upon the fraction of the intermittent cycle occupied by the photic pulse. Conventionally, the ratio represented is called the *LDR* (light-dark-ratio). Since light and dark are perceptual rather than stimulus terms, we prefer to substitute henceforth, the name, pulse-to-cycle-fraction (*PCF*) when actually describing the nature of the stimulation used. In Bartley's original paper, no extensive report on brightness enhancement in relation to *PCF* was given. It is a report on this that is the content of the present paper.

B. PROCEDURE

As was indicated in the preceding section, the *PCF* of an intermittent target was varied in our present experiment. The target was a disk-ring

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combination. The disk, 1⅛″ in diameter, lay within the ring. The inner border of the ring was separated from the outer border of the disk by about 5/16″. The ring was 5/16″ in width and thus its outer borders subtended a diameter of 2⅜″. The target was viewed from an effective distance of 30″. The disk was the intermittent portion of the target and the ring was held at a steady luminosity level during each trial. Four levels of ring luminosity were used: 13, 60, 100, and 150 c/ft^2, or in terms of decibels: 86.3, 93.07, 95.29, and 97.05 decibels, respectively (12, 16). The *PCF* values were 0.2, 0.3, 0.5, 0.7, and 0.9 as provided by an episcotister. The pulse rates were 10.6 and 32 per second. The lower pulse rate was used to match approximately the human alpha rhythm, and the higher rate was an approach to the critical flicker frequency, although the approach was not equal for each of the four levels of luminosity (Ferry-Porter law).

Under certain circumstances, both Bartley (9) and Halstead (14) obtained maximal brightness enhancement at the approximate alpha rate. Brightness enhancement declined when higher frequencies were used, and, of course, at c.f.f., the Talbot effect was obtained.

The results reported are from two trained observers. The curves in Figure 1 represent the averages of their performances which generally were quite close together. All points on the curves represent at last 30 readings for each observer—some as many as 90 readings.

C. RESULTS

The results of comparing the intermittent portion of our target with the steady portion in brightness are shown in Figure 1. On the left is a family of curves for the 10.6 per second pulse rate, and on the right, a family of curves for the 32 per second pulse rate.

For the low pulse rate, all points except one, on all curves represent greater effectiveness for the intermittent than for the steady target. The single exception was just barely below the enhancement range. Each curve is for a different target intensity on both sides of the figure. Beginning with the longest pulse durations and moving toward the shorter ones, the following may be said. Enhancement starts at a moderate amount, quickly declines and then at about a *PCF* of 0.7, enhancement rises quickly to a *PCF* of 0.3. The effects are almost linear, if not actually so in most cases. With pulses shorter than 0.3 of the cycle, enhancement again declines. The same general pattern is true for the results with the high pulse rate, except that the rise in the maximum enhancement portion of the cycle begins with shorter pulses. Of course, the lower pulse rate produced, by far, the greater amount of enhancement.

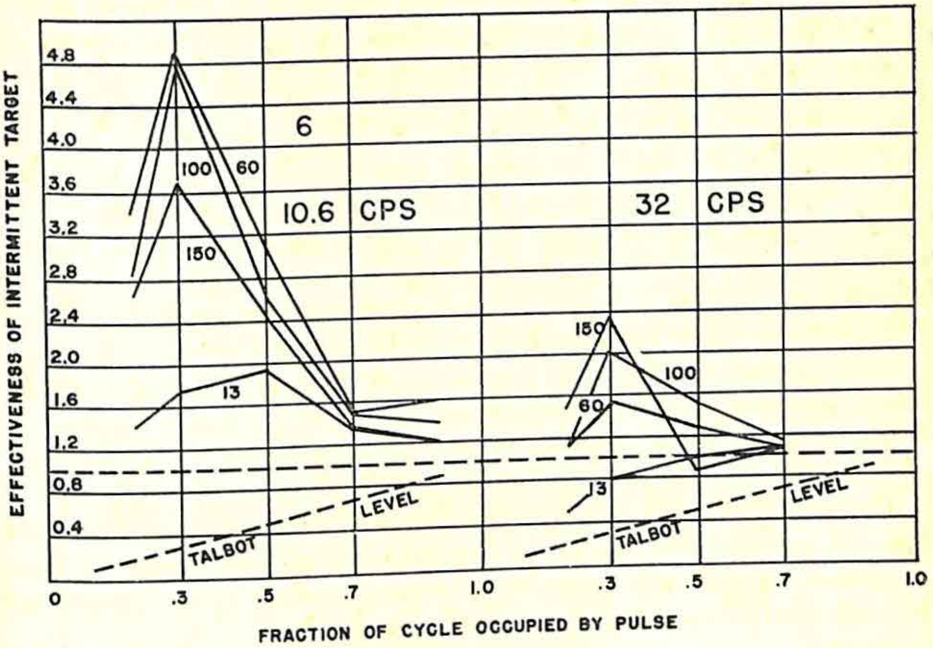

FIGURE 1
The relation of the effectiveness of intermittent stimulation to the fraction of the cycle occupied by the pulse. The horizontal line represents the effectiveness of steady stimulation of the same intensity as the intermittent.

D. DISCUSSION

In all of the work on brightness enhancement, Bartley has attempted to test one of the possible mechanisms responsible for it. The nature of brightness enhancement and the nature of the extended work on the electrophysiology of the optic pathway has led him to base brightness enhancement upon neurophysiological principles rather than exclusively upon photochemical reactions. The latter are involved, of course, in all occasions, but here, the critical events seem to lie, for the most part, in the central nervous system.

The neurophysiological mechanisms of which the alternation of response theory (5, 6, 7, 10, 11) is the statement of the significant aspects has been described elsewhere. It is the relevancy of the alternation of response theory to our present results that we are trying to test.

According to a simple interpretation of this theory, one would expect that, as the pulse fraction of the cycle is progressively reduced, i.e., as *PCF* is made lower and lower, brightness enhancement would be increased. Shortening the photic pulse would ultimately preclude restimulation of the same channels of the optic pathway by the same pulse, and would reduce the temporal distribution of activity. According to the theory any factor working toward distributing the activity of various channels of the optic pathway throughout the stimulus cycle would work toward reducing brightness enhancement. So far, the stimulus factors that make for specific cortical responses to repeated stimuli being amplitudinous have worked in favor of brightness enhancement and it would seem that in the present manipulations of the *PCF* we have produced another example of the same parallelism. This is to say, we have shown that with a pulse frequency in the neighborhood of the alpha rhythm, brightness enhancement increases as pulse duration is shortened from occupying 0.7 cycle to occupying 0.3 cycle. The increase in brightness enhancement is great. A moderate amount of enhancement is found under the same *PCF* manipulations at a pulse frequency near the c.f.f., but its manipulation differs from that found at 10.6 cycles per second.

We shall consider the features of the curves for the 10.6 per second pulse rate first. The curves deviate from the very simplest expectations in several ways and thus raise several questions the answers to which must be sought by further experimentation. One is—why do the curves for the higher intensities (150, and 100 c/ft^2) show less enhancement than for the moderate intensity (60 c/ft^2)? Our suggested answer takes into account the spatial features of the target components. The intermittent part of the target, the disk, was enclosed within the steady part of the target, the ring, with only a small space intervening. Thus it is thinkable that with very high intensities, the stray radiation on the retina was sufficient to cause a material amount of interaction between the two parts of the retina corresponding to the two parts of the target image. If this were to be the case, it would be expected to oppose increases in pulse intensity. As was said, however, the matter needs investigating. For the present, our results will not be considered as opposing the alternation of response theory of brightness enhancement (6, 7).

The second way the curves deviate from simple expectations is that they all reach a peak with moderately short pulses and decline with very short pulses. All curves for a pulse frequency of 10.6 per second reach a peak when the pulse occupies 0.3 of the cycle. It is not known exactly where the peak is, but by the time that the pulse is reduced to 0.2 cycle, the enhancement has materially dropped. Two factors may be at work here, and just what weight they may bear cannot be determined without further experimentation. One factor is the reduction in the total flux as the pulse is reduced from 0.3 to 0.2 cycle. This total flux may not be great enough to maintain the pulse quantity in the range producing maximal enhancement. This can be tested by equating all pulses used, through compensating for reduction in duration by increase in intensity.

The second possible reason for the decline of the curves is a limitation imposed by the design of the apparatus. The flux reduction as the open sector of the disk was reduced from 0.3 to 0.2 cycles was found to be different than would have been expected from the disks themselves. To correct the difficulty would have required a wholly different setup. Hence this and certain other problems that arose were thought best left to a subsequent investigation.

Two factors would seem to enter in dealing with *PCF*'s longer than 0.7 in the present situation. One of them is the form of the apparatus used and since it precluded accurate information, the rôle of the second could not be accurately observed. The factor just alluded to is the inhibition of the off-response of the retinal discharge. With long pulses in the cycle, the quiet periods between would be reduced to a minimum and off-responses would be inhibited. This might work toward a more uniform distribution of activity throughout the cycle at the cortical end of the pathway. As was said earlier, whatever works toward spreading the activity through the cycle rather than toward bunching it, reduces brightness enhancement. There is another way of looking at the matter, however, and a way of distinguishing between the two needs to be found. According to the second view, the elicitation of an off-response might be expected to inhibit certain cortical activities and thus make for flicker. In so doing, it would tend to inject a dark component or reduce net brightness. Preclusion of the off-response ought thus to increase brightness.

The inflections of the curves for the 32 per second pulse rate are not like those for the slow rate. This can be attributed to the fact that c.f.f. is being approached.

E. SUMMARY

The *PCF*, the pulse-to-cycle fraction of the intermittent stimulation was manipulated from 0.2 to 0.9 for two different photic pulse rates, 10.6 and 32 cycles per second. It was found that, according to expectations, shortening the pulse increased brightness enhancement, except for terminal condi-

tions which were discussed. The results for these conditions do not seem to run counter to the expectations from what we know about the neurophysiology of the optic pathway including the interpretation known as the alternation of response theory. In fact, the present findings tend to corroborate the theory.

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PRODUCTIVITY AND RECALL IN COÖPERATIVE AND COMPETITIVE DISCUSSION GROUPS*[1]

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A. INTRODUCTION

Recent research on the induction of change has revealed the importance of utilizing the group as the unit of change and providing for the active participation of group members (3, 6, 7, 8). The findings have led to an increased popularity of collaborative approaches and an extension of their use into areas which have not been adequately explored.

In these investigations authority figures, when present, have been admonished to be permissive and warm. Their function is primarily one of helping group members to solve their own problems. However, there are some settings in which an additional element is present. The authority figure must at some time serve as a judge and evaluate the performances of individual group members. This function is explicitly recognized and results in intermember competition. The effects of this competition are not altogether clear.

The present investigation was undertaken to explore one aspect of this problem: What are the effects of competition and coöperation upon the productivity of discussion groups and the retention of the material produced?

B. THE PROBLEM

In the early stages of group development,[2] an observer is impressed by the number of cogent statements made by group members. These remarks concern basic issues confronting the group, the delineation of group problems, and suggestions for solutions to these problems. However, these contributions appear to get lost in the discussion and are perceived as being entirely new when they reappear much later. Group members seem to be baffled when they listen to a recording of a meeting and suddenly discover what was actually said.

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[1] This study was supported by a grant from the University of Kansas Research Fund.

[2] These descriptions are based on observations made of classes in group dynamics and training groups at the National Training Laboratory in Group Development.

It would appear that this result might be attributable to the fact that in the formative stages of the group, each member (or most members) is concerned about his eventual status. This concern places him in competition with others which in turn leads to less acceptance of these fellow group members and of their contributions. It would seem reasonable to believe that this would result in either an ignoring of the original contribution or a later repression of it. Consequently, group members would not be expected to benefit fully from the unique contributions and insights of their colleagues.

Another observation of possible relevance concerns the frequency of periods of silence in the initial phase of group development. The situation in which group members find themselves is only partially structured and known. This lack of clarity in structure is threatening and tension-inducing. There is no certainty concerning what type of behavior is appropriate and what is inappropriate. Inaction might be seen as the safest course. This is more likely to be true in a competitively oriented group in which one's own errors benefit one's competitors.

Later, in what is presumably an interdependent phase, there is an increased continuity in discussion and a greater concern with listening. Those periods of silence that do occasionally occur are not so tension-provoking.

It would seem desirable to determine whether the apparent differences in developmental stages and the apparent characteristics of these stages could be reproduced in a laboratory setting by creating competitive and coöperative relationships among group members and noting whether or not they are accompanied by the characteristics previously observed. Consequently the following hypotheses were formulated and were investigated in the present study:

I. Coöperatively oriented groups are more productive of ideas in group discussion than are competitively oriented groups.

II. Coöperatively oriented groups recall more material from group discussions than do competitively oriented groups.

III. In competitively oriented groups the proportion of the recalled material that is derived from one's own statements will exceed that expected by chance to a greater degree than in coöperatively oriented groups.

One additional empirically derived hypothesis was proposed following the analysis of data gathered from the first 11 groups. The results obtained were so striking that it seemed imperative to accumulate additional data. This hypothesis states:

IV. Regardless of group orientation, the proportion of the recalled material that is derived from own statements is greater than might be expected by chance.

C. PROCEDURES

1. *Subjects*

The subjects in this investigation were 145 students who were enrolled in undergraduate courses in psychology and sociology. The members of the classes involved were asked to inspect copies of the class rolls and to place a check opposite the name of every individual with whom they were acquainted, casually or otherwise. They were also asked to submit a copy of their individual schedules indicating during which hours they would be free to participate in the experiment. On the basis of this information the students were assembled into 29 groups of five persons each so that each group was homogeneous with respect to sex and so that no group contained individuals who were acquainted.

2. *Group Discussion*

Fourteen of the groups were given the following instructions with the intention of inducing a competitive attitude:

> As you know, psychologists have made great strides in the measurement of intelligence. However, the tests they have developed require that an individual perform in isolation, whether it be an individual test or a group test. We feel that for some purposes it would be better to measure intelligence in a social setting. By noting the behavior of each of you in an interpersonal situation we should be able to determine much more accurately how effective you are in the use of your abilities. This would permit us to rate you individually in a test situation.
>
> For this purpose we shall ask you to undertake the solution of a problem through group discussion. This problem will not have a single, simple answer. Rather it is complex and many answers are possible, though some are much better than others. You are asked to attempt to get the best solution you can, based on the fullest understanding of the situation.
>
> Are there any questions about that?
>
> You will be given about five minutes to read and think about the problem. At the end of that period you will be permitted to discuss it for 15 minutes.

For the remaining 15 groups the instructions were identical except for the first paragraph which read:

> As you know, psychologists have made great strides in the measurement of the intelligence of individuals. Recently our interest in the functioning of small groups has increased. It has become apparent that

> in many ways the group is like an individual. Thus it has seemed important to us to develop some measure of the ability of a group that would be like our measure of the intelligence of the individual—a kind of group *IQ*. By examining the way a *group as a whole solves* its problems, we should be able to characterize the effectiveness of that group. After testing a number of groups we should be able to say, "This group is better than all others" and so forth.

It was hoped that these instructions would establish a coöperative relationship among the participants.

In order to control for possible differences in classes, half of the groups from each class were given one set of instructions, the other half received the other instructions. Exceptions occurred only in those instances in which an uneven number of groups was drawn from a class.

Each person in the group was given a mimeographed copy of the case, Jinny Stover (2), to study for a period of five minutes. Following this the members of the group were asked to begin their discussion. The case discussion was recorded and the experimenter who remained in the room kept a running record of the interactions so that it was possible to determine the source of each statement. This discussion was later transcribed.

3. *Recall Test*

After an interval of approximately six weeks the students were approached as a group during their regular class meetings and were told:

> Several weeks ago you participated in an experiment in which you discussed the case of Jinny Stover. As you may recall, Jinny, nine years old, was an adopted child who, soon after moving to a new house, came home from school upset and crying and for some two weeks had stayed at home crying constantly. Her mother had interviewed various persons to try to find the cause of the crying. Jinny wouldn't tell about it, but after two weeks revealed that "If I go to school I won't be able to do my arithmetic, and if I can't do my arithmetic, the teacher will slap my face and make me cry. If I cry I can't eat my lunch, and the teacher will make me sit in a corner." The brother told the mother, "Why, Mummy, I thought you knew that!" A friend of the family, Miss Mildred Cary, to whom the parents had appealed for help consulted a psychologist, Dr. Parker.
>
> This should help you recall something of the problem.
>
> Now we should like you to write down as much as you can recall of your group's discussion of the problem. This might include comments concerning the nature of the problem, suggestions for a solution, evaluations of suggestions, etc. Ideally you would write out a word for word account of your discussion. This is, of course, impossible,

> but we should like to have you write down every single idea or comment that you can remember. If you cannot recall the exact comment but do recall its nature, rephrase it in your own words.

The subjects were given 30 minutes to record everything they could recall of the original discussion. No one required additional time.

D. ANALYSIS

1. *Discussion and Recall Data*

The transcriptions of the group discussions were submitted to two judges who were asked to extract independently every distinguishable idea, e.g., diagnosis, elaboration, solution, that was not part of the original case. Record was kept of the source of each of these contributions and instances of explicit agreement with the contribution. These individual contributions and statements of agreement constitute a part of the raw data. Examples of ideas introduced include:

> "I believe also by her crying like she was—she felt she could gain a lot of pity from her parents."
>
> "I think she should be assured that everyone loves her."
>
> "Maybe you could also give her tutoring in arithmetic."
>
> "Wouldn't that be evading the issue if she went to another teacher?"

Following the analysis of the transcript of each group, the two judges discussed their results and reached joint decisions concerning disagreements. In the initial stages, the independent judgments were identical for approximately 83 per cent of the contributions. This agreement increased to approximately 90 per cent as the judges through discussion approached common standards.

The transcribed recall materials were also submitted to the two judges who extracted the individual recalls. Each recall was then compared with the original data to determine whether it had actually appeared in the transcript and who had introduced it or explicitly agreed with it. As a result of absences and withdrawals, the number of subjects whose recall materials could be analyzed was reduced to 119.

Five scores for each person were derived from the protocols: (*a*) number of statements that were initiated; (*b*) number of statements that were initiated or explicitly agreed with; (*c*) number of statements initiated or explicitly agreed with that were recalled; (*d*) number of other's statements that were recalled; (*e*) total number of statements that were recalled.

It should be emphasized, however, that in evaluating the hypotheses mean scores for each group were employed rather than individual scores. The techniques used in obtaining these scores are elaborated in the following section.

2. *Statistical Treatment*

A casual examination of the data suggested that the magnitude of the scores was related to the class from which the groups were drawn. This made it necessary to derive scores which were independent of the class. The method employed involved computing a mean for each class and determining the deviation of each group from that mean. For example, six groups drawn from a junior-senior course in General Psychology yielded the following results, each number indicating the mean number of contributions from members of that group; Competitive: 9.0, 8.4, 8.2; Coöperative: 10.2, 9.2, 9.2. The grand mean is found to be 9.03 and the deviation scores: Competitive: —.03, —.63, —.83, Coöperative: 1.17, .17, .17.

These deviation scores and equivalent data derived from other classes were analyzed to test Hypothesis I.

An identical procedure was used for testing Hypothesis II.

In order to test Hypotheses III and IV it was necessary to determine what proportion of an individual's total recalls should have been derived from his own contributions or explicit agreements on a purely chance basis. It was reasoned that if recall occurred unrelated to source, one should expect that the proportion of total recalls derived from one's own statements would equal the proportion of the total statements for which that individual was responsible. Thus, Individual *A* is responsible for 12 relevant statements out of a total of 55 for his group. We should then expect that on the basis of chance 21.8 per cent of his recalls would involve ideas he has expressed. We discover that of the 14 items he recalled, 8 or 57.1 per cent are his own. The difference between the obtained and the expected proportions is .353. Similar scores were computed for each individual and means determined for each group.

In testing Hypothesis III an effort was again made to correct for differences among classes as described above. Class means were computed, each group's deviation from its appropriate mean was determined.

In the final analysis (Hypothesis IV) no correction for class differences was necessary for no comparison was to be made between coöperative and competitive groups. The mean difference score (obtained minus expected) was determined for each group and the significance of their difference from zero determined.

E. RESULTS

The analysis of the data concerning the differential rate of contributing and recalling of competitive and coöperative groups is summarized in Table 1.

It is found that significantly more ideas are introduced in coöperative groups, thus supporting the first hypothesis. This result might be illustrated more clearly by noting that the number of contributions in coöperattive groups exceeds that in competitive groups by approximately 15 per cent.

There is no significant difference between coöperative and competitive groups in frequency of recall of the discussion material. The slight difference that is revealed is in favor of the coöperative groups.

TABLE 1
CONTRIBUTIONS AND RECALLS OF COMPETITIVE AND COÖPERATIVE GROUPS: SCORES REPRESENT AVERAGE OF DEVIATIONS OF GROUP MEANS FROM THEIR RESPECTIVE CLASS MEANS

	Competitive	Coöperative	*SE* Diff.	*CR*	*P*
Contributions	—.70	+.70	.49	2.86	<.01
Recalls	—.27	+.26	.47	1.13	.26

TABLE 2
DIFFERENCE BEWEEN OBTAINED AND EXPECTED PROPORTION OF RECALL OF OWN MATERIAL FOR COÖPERATIVE AND COMPETITIVE GROUPS
(CORRECTED FOR CLASS MEANS)

	Obt-Exp	*SE* Diff.	*CR*	*P*
Competitive	—2.15	4.35	.968	>.30
Coöperative	+2.06			

The results of the test of Hypothesis III are shown in Table 2. Contrary to the hypothesis, individuals in competitively oriented groups are not more prone to recall their own statements than are individuals in coöperatively oriented groups, the test of the significance of the difference between the means yielding a probability value of approximately .35. The slight, insignificant difference that does exist is opposite in direction to that hypothesized.

In testing the fourth hypothesis it was necessary to determine the proportion of total recalls that could be expected to be derived from one's own statements solely on the basis of chance. The actual proportion was then computed and the difference obtained. The average difference for each group was then determined. The distribution of these differences is found in Figure 1. The mean difference for all groups is 25.5 with a standard deviation of 2.42. The critical ratio is found to be 10.54 with $P < .001$. It will be recalled that Hypothesis IV was derived from an examination of the data collected from the first 11 groups. If the data from these groups are excluded and only those from the remaining 18 groups analyzed, the mean difference is found to be 27.63, the standard deviation is 2.81, and the resulting critical ratio, 9.83.

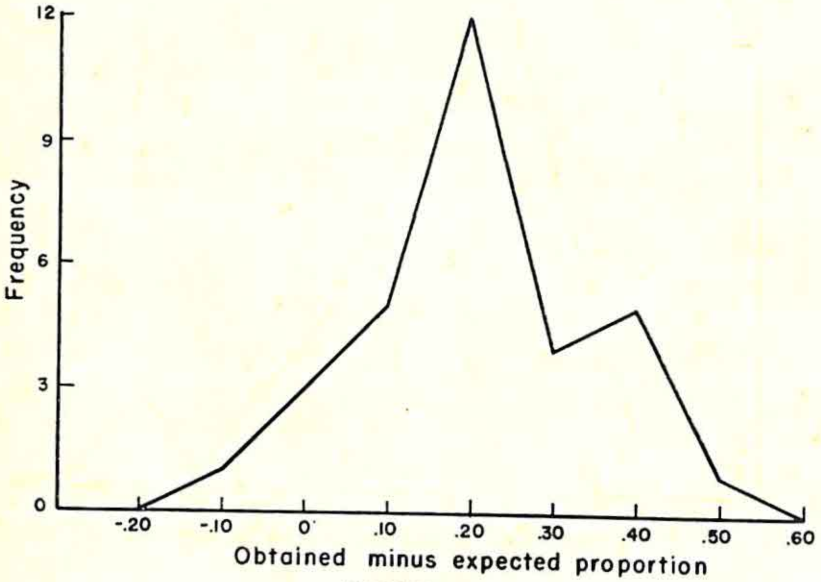

FIGURE 1
DISTRIBUTION OF GROUP MEANS: MEAN DIFFERENCE BETWEEN OBTAINED AND EXPECTED PROPORTION OF MATERIAL RECALLED THAT IS DERIVED FROM OWN STATEMENTS

This result can be made more concrete by recognizing that on the average, each member of a five-man group is responsible for 20 per cent of the contributions or explicit agreements that appear in the group discussion. By chance, 20 per cent of his recalls should derive from his own statements. In actuality, 45.5 per cent of the material he recalls is derived from his own statements.

Although the data were analyzed by groups rather than by individuals to circumvent the problem of dependence, it might be illuminating to inspect the distribution of obtained minus expected proportions for individuals. These data are presented in Figure 2. The distribution of individual scores closely resembles that of group mean scores, though the variability, as might be expected, is greater.

F. Discussion

It would appear from these results that frequency of contributing is significantly higher in coöperative groups than in competitive groups; that there is no distinction to be made between these groups with respect to amount of material recalled; that the tendency to recall one's own statements is not related to group orientation; and, finally, that there is a pronounced tendency to recall one's own statements.

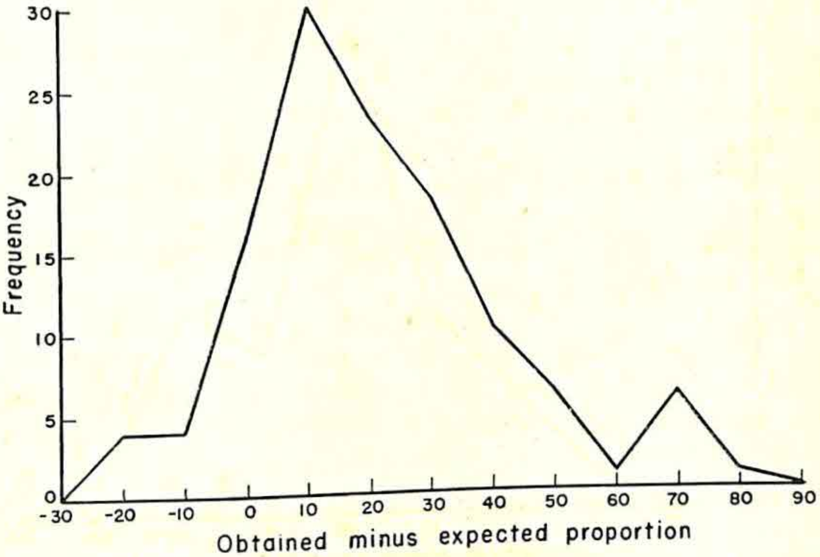

FIGURE 2
Distribution of Differences between Obtained and Expected Proportions of Material Recalled That Is Derived from Own Statements

It should be recognized immediately that the instructions might not have induced coöperative and competitive attitudes in the same degree one might find them in naturally occurring groups. To the extent that this is true, hypotheses involving differential predictions (I, II, III) would not be tested adequately. However, for the purposes of the present discussion this problem, common to much of social psychological research, will be set aside.

The results of the test of Hypothesis I are consistent with those reported by Deutsch(4) who found that productivity in the discussion of human relations problems as measured by the number of words in written letters of recommendation was greater for his coöperative groups than for the competitive groups.

In comparing the situations with which the two kinds of groups are confronted we find that both sets of instructions have posed common problems: an understanding of the case of Jinny Stover and recommendations for the disposition of the case. However, an additional problem develops which is more crucial for the competitive groups. They mus[illegible] more concerned with questions of intragroup relations because signi[illegible]ntributions to the discussion now have dual consequences: the con[illegible]moving toward a solution of the problem simultaneously tend [illegible]wn goal and to deprive his competitors of the opportuni[illegible] goals. One of the consequences of the resulting conflic[illegible]e in the restraint exercised by group members. This co[illegible]r in the present context, considering the brief duratior [illegible] and the setting. The result would be less productivit[illegible] than [illegible] the coöperative groups.

An understanding of the remaining significan[illegible] result (Hypothesis IV) requires an examination of the manner in which t[illegible] case is approached by individual group members. Each person in reading the material develops his own unique conception of the problem as influenced by his values, prior experience, etc. This unique conception or schema (Bartlett, 1) provides him with an interpretation which is relatively meaningful and congenial. It should be noted parenthetically that these schemata are not wholely unique and some commonality does run through the schemata of various persons.

Each person in discussing the case presents what is salient from his own point of view or in other words what is consistent with his schema and also important. The contributions made by others may relate in various ways to this schema. Some of the contributions are consistent with it and can easily be incorporated. Evidence for this can be available in the form of statements of agreement. Others are neither consistent nor inconsistent, with the result that the schema is neither threatened nor reinforced. These contributions will be far less likely to influence the schema or be incorporated in any way. Finally, there are ideas introduced which are quite inconsistent with the schema. The consequences of such incongruity have been explored by Haire and Grunes (5), who have described the processes of denial, encapsulation and distortion, change in organization, and recognition of incongruity. It is apparent from their findings that a genuine change in the schema is most unlikely to result from the introduction of incongruous material. In other words, the material that an individual carries with him from a group discussion will be predominantly that which conforms to his schema.

When the subject is approached at a later date and asked to recall in detail the content of the discussion, that which he is most likely to have retained in his schema and not the isolated contributions. In attempting to reproduce content, he will most likely recall that which is consistent with and derivable from his schema. This would tend to include his own contributions, the contributions of others that were consistent with his schema, and the contributions of others that were inconsistent but resulted in some modification of the schema. He will be least likely to recall material that is irrelevant to his schema, or inconsistent with it. In short, the material most likely to be recalled is that which is consistent with his schema, and the material most likely to be consistent with his schema is that which he introduced or agreed with. This interpretation makes intelligible the results of the test of Hypothesis IV.

G. SUMMARY

This investigation was undertaken to determine some of the effects of competition and coöperation on the productivity of discussion groups and the retention of the material produced.

Twenty-nine groups of five persons each were studied. Subjects were students who were enrolled in undergraduate courses in psychology and sociology. Fifteen of the groups were given instructions that were designed to induce a coöperative attitude. The remaining 14 groups received instructions that were intended to induce a competitive attitude. Each group was given a copy of a case to study and then asked to discuss it.

After an interval of six weeks the subjects were asked to recall as much as possible of the original discussion.

From these data it was possible to determine sources of original contributions, explicit agreements with contributions, and the amount and source of recalled material.

Within the context of the study the following hypotheses were confirmed:

1. Coöperatively oriented groups are more productive of ideas in group discussion than are competitively oriented groups.

2. Regardless of group orientation, the proportion of the recalled material that is derived from own statements is greater than might be expected by chance.

The following hypotheses were not supported:

1. Coöperatively oriented groups recall more material from group discussion than do competitively oriented groups.

2. In competitively oriented groups the proportion of the recalled ma-

terial that is derived from one's own statements will exceed that expected by chance to a greater degree than in coöperatively oriented groups.

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A STUDY OF THE DESCRIPTIVE VALIDITY OF ACTIVITY VECTOR ANALYSIS*

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A. INTRODUCTION

The Activity Vector Analysis (*AVA*), an instrument yielding temperament measures, is widely used in industry as a selection tool (1).

There are four published validity studies of this test (2, 3, 5, 10). Three of these (2, 5, 10) are of the nature of criterion validity studies where "success" in a specific job is the external criterion. One (3) is an occupational differentiation study. Since *AVA* profile scores yield general behavioral descriptions rather than predict or indicate the strength of single attributes, it may well be that the validity of these descriptions is more fundamental in judging the over-all validity of this instrument than are validities of any consequent prediction of performance criteria (5, 7, 8).

In industry, such test based descriptions of temperament may be used, for example, to predict success as a particular kind of machine operator. This assumes two kinds of "valid" knowledge on the part of the predictor. First, the validity of the temperament description of a tested individual is assumed and, second, the validity of an existing model or "ideal" temperament for the job is assumed.

This study deals with the first kind of validity—descriptive validity. In it we attempted to measure the accuracy of personality or temperament descriptions of test subjects based on test scores. It will be seen that our design and rationale parallel other studies such as Halbower (6) and Sundberg (9).

B. PROBLEM AND STATEMENT OF HYPOTHESIS

1. *Problem*

To examine the descriptive validity of *AVA* by evaluating the accuracy of descriptive paragraphs based on *AVA* Resultant Profile Scores.

2. *Hypothesis*

AVA Profiles yield accurate descriptions of temperament.

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*Received in the Editorial Office on January 20, 1957, and published immediately at Provincetown, Massachusetts. Copyright by The Journal Press.

3. *Proposition*

Test based temperament descriptions representing *AVA* Resultant Profiles will be chosen as correct significantly more often by (*a*) test subjects, and (*b*) selected associates, than will be false distractor descriptions.

C. MATERIALS

AVA Placement Analysis Form *A* was the instrument used.

When scored, this instrument yields a profile indicating, on a series of *T* score scales, the relative values of the total number of words checked (activity) and the number of words falling under each of the four prime vectors (Figure 1).[1] Scores are separately computed for each of two separate checkings. The instructions for the first being, in part: "Place an X in the columns headed (1) before every word that has *ever* been used by *anyone* in describing you . . ." and for the second, ". . . place an X in the columns headed (2) before every word which you honestly believe is descriptive of you."

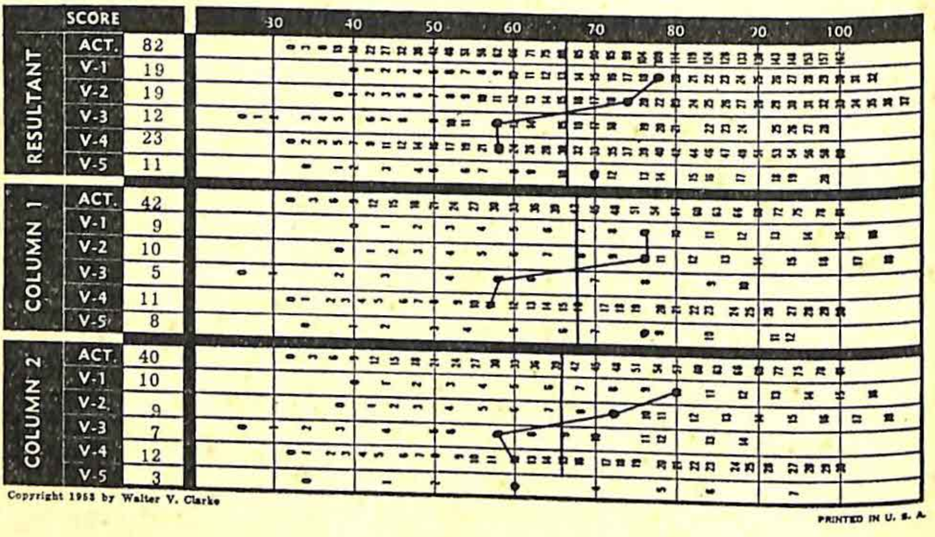

FIGURE 1
AVA PROFILE SUMMARY
CARD

The plotted scores yield profiles for Column 1 and Column 2. Their numerical sum, when plotted on the Resultant *T* Scales, also yields a profile known as the Resultant Profile. It was this profile that was utilized for interpretation as the source of the descriptive paragraphs.

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[1] For a further discussion, see Clarke (1, and 4).

A number of relevant variables, e.g., Column 1 profiles, Column 2 profiles, and their interrelationships, activity level, V-5, etc., were thus excluded from consideration, resulting in a loss of sensitivity and accuracy of description and eliminating these items from validation. It was believed, however, that this oversimplification and reduction of sensitivity was compensated for by the resulting economy of design of the study. It was further believed that any positive results obtained with this sharply curtailed use of the *AVA* would be suggestive of even higher validity for the over-all instrument results.

One variable, profile deviation, was utilized to evaluate and analyze the over-all data, but did not enter into the construction of the prototypical descriptive paragraphs. Profile deviation is described as the difference in *T* scale units between the highest and lowest vector scores in a profile. E.g., in Figure 1, profile deviation in the resultant scale is the difference between the V-1 and V-3 or V-4 score, 2.0 sigma units. In the Column 1 profile, profile deviation is the difference between the V-1 or V-2 score and the V-4 score, about 1.9 sigma units. In Column 2, the profile deviation is the difference between the V-1 score and the V-3 score, about 2.2 sigma units.

For purposes of simplification, fourteen "basic" test profiles were established and descriptive paragraphs were written for each one. The basic profiles were based on simple combinations of four scores about their mean, as shown in Table 1.

TABLE 1
BASIC PROFILE VECTOR COMBINATIONS
(Vector relationships used in establishing basic profiles.)

Pattern number	High vectors (above mean)	Low vectors (below mean)
1	1	2, 3, 4
2	2, 3, 4	1
3	1, 4	2, 3
4	2, 3	1, 4
5	1, 3, 4	2
6	2	1, 3, 4
7	1, 3	2, 4
8	2, 4	1, 3
9	1, 2	3, 4
10	3, 4	1, 2
11	1, 2, 4	3
12	3	1, 2, 4
13	1, 2, 3	4
14	4	1, 2, 3

TABLE 2
INTERCORRELATIONS OF BASIC PATTERN SHAPES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00													
2	—1.00	1.00												
3	.58	— .58	1.00											
4	— .58	.58	—1.00	1.00										
5	.33	— .33	.58	— .58	1.00									
6	— .33	.33	— .58	.58	—1.00	1.00								
7	.58	— .58	.00	.00	.58	— .58	1.00							
8	— .58	.58	.00	.00	— .58	.58	—1.00	1.00						
9	.58	— .58	.00	.00	— .58	.58	.00	.00	1.00					
10	— .58	.58	.00	.00	.58	— .58	.00	.00	—1.00	1.00				
11	.33	— .33	.58	— .58	— .33	.33	— .58	.58	.58	— .58	1.00			
12	— .33	.33	— .58	.58	.33	— .33	.58	— .58	— .58	.58	—1.00	1.00		
13	.33	— .33	— .58	.58	— .33	.33	.58	— .58	.58	— .58	— .33	.33	1.00	
14	— .33	.33	.58	— .58	.33	— .33	— .58	.58	— .58	.58	.33	— .33	—1.00	1.00

The descriptive paragraphs were derived from empirical and theoretical concepts developed by Clarke and Associates, regarding the meaning of the relative interrelations of the four vectors (1, 4).

The degrees of similarity or difference among the 14 prototype profiles can be expressed by the modified correlation coefficient:

$$r = \sqrt{\frac{(\Sigma X_1^2 + \Sigma X_2^2 - \Sigma D^2)^2}{4(\Sigma X_1^2)(\Sigma X_2^2)}}$$

Where ΣX_1^2 = summation of the four squared T score values for the vectors in one profile expressed as deviations from its mean.

Where ΣX_2^2 = summation of the four squared T score values for the vectors in the other profile expressed as deviations from its mean.

Where ΣD^2 = summation of the four squared differences between corresponding vectors of the two profiles when the vector values are expressed as deviations from their own T score means.

This formula applied to Table 1 profiles yields the intercorrelation matrix shown in Table 2. From this table, 14 pairs of profiles were selected. These pairings are shown in Table 3.

TABLE 3

DESIGN FOR DESCRIPTION PAIRING

Series	Description sheets	Paired description numbers	Correlation between profiles
A to G	A	1 vs. 14	— .33
	B	11 vs. 2	— .33
	C	3 vs. 8	.00
	D	9 vs. 4	.00
	E	13 vs. 5	— .33
	F	12 vs. 6	— .33
	G	7 vs. 10	.00
J to P*	J	1 vs. 2	—1.00
	K	3 vs. 4	—1.00
	L	5 vs. 6	—1.00
	M	7 vs. 8	—1.00
	N	9 vs. 10	—1.00
	O	11 vs. 12	—1.00
	P	13 vs. 14	—1.00

*(Series J-P was used only with one group, Group *B*, Table 6.)

In accordance with the pairings of Pattern Shapes, the descriptive paragraphs for the profiles were printed together on sample description sheets. Tables 4 and 5 show sample sheets *D* and *N* respectively.

TABLE 4

SAMPLE DESCRIPTION SHEET—SERIES *A* TO *G*: SHEET *D*

—9—	—4—
This man is most effective in a situation which requires leadership. He shows forcefulness in working with things as well as with people. He combines vigor, self-assuredness, and persuasion. In addition to independence, self-confidence, and enthusiasm, people note in this man some tension and some venturesomeness. He influences others by his willingness to stick his neck out. He is a go-getter. He is eager to try new ideas and is willing to buck opposition. He is usually inspiring, hearty, and poised in his dealings with people. Responsibility and social recognition are what he wants most. He accepts supervision when it is perceived as an aid to his self-advancement, but resists it, when it is perceived as restraining.	This man is most effective in a situation where a sincere interest in helping people and a good-natured, easy-going attitude are desired. He likes a situation which involves low pressure and deliberation in the solution of new problems. In addition to warmth and inner calm, people feel in this man: confidence, stability, and unselfishness. This man sees himself as a kindly person who is anxious to help others. He enjoys working for some charitable or benevolent cause. Sympthetic appreciation of his efforts is effective in motivating him. He tends to avoid new ventures and controversy. He needs supervision that will help him to direct his activities toward practical business goals.

TABLE 5

SAMPLE DESCRIPTION SHEET—SERIES *J* TO *P*: SHEET *N*

—9—	—10—
This man is most effective in a situation which requires leadership. He shows forcefulness in working with things as well as with people. He combines vigor, self-assuredness, and persuasion. In addition to independence, self-confidence, and enthusiasm, people note in this man some tension and some venturesomeness. He influences others by his willingness to stick his neck out. He is a go-getter. He is eager to try new ideas and is willing to buck opposition. He is usually inspiring, hearty, and poised in his dealings with people. Responsibility and social recognition are what he wants most. He accepts supervision when it is perceived as an aid to his self-advancement, but resists it, when it is perceived as restraining.	This man is most effective in precision work, in being a guardian of established truth, or in following an admired leader. He is responsible but not responsibility-seeking, easy-to-get-along-with but not popularity-seeking. In addition to preference for detail, people note in this man: quietness, courtesy, modesty, and a somewhat dependent attitude towards authority. This man attempts to be effective by being a good follower of people and of methods. He is steady, patient, careful, and conscientious in his work. He has no desire to dominate nor to be a social leader. He may best be motivated by considerate treatment, by rewards for loyalty, and by a supervision which he considers to be fair, well-informed, and friendly.

D. SUBJECTS

Subjects were 219 College students drawn from three New England campuses. They were members of four groups; two fraternities (designated Groups *A* and *B*) on the campus of an Ivy League University, a fraternity at a State University (designated Group *C*), and a freshman psychology class at a Technical College (designated Group *D*). The fraternity groups were all male, of course. The freshman psychology group was comprised of 49 males and 32 females.

Table 6 shows the distribution of the groups according to college year. Rating was done in the middle of the second semester. Students thus ranged in length of acquaintance for purposes of ratings, from a minimum of four months to a maximum of 30 months.

TABLE 6
DISTRIBUTION OF COLLEGE CLASSES WITHIN THE FOUR SUB-GROUPS

Class	Group *A*	Group *B*	Group *C*	Group *D*	Total
Freshman	9	19	0	80	108
Sophomore	16	13	12	0	41
Junior	13	9	17	0	39
Senior	11	11	9	0	31
	49	52	38	80	219

E. DATA COLLECTION PROCEDURE

A meeting was arranged with each group of *S*'s and the over-all procedure was explained to them.

AVA Placement Analysis Forms *A* were administered following standard administration procedures (4) and, at the same time, each *S* was asked to write on the back of the form, the names of two persons he knew well enough to rate.

The completed forms were then scored and the "Resultant" profiles were plotted and arbitrarily classified as belonging to one of the 14 basic profiles (Table 1). Table 7 shows the distribution of profile patterns within the groups.

The corresponding profile paragraph was then classified by the experimenter as "True" for each *S* and a sheet containing the "True" and a matched "False" distractor paragraph was assigned for all ratings of this *S* by Self and Other raters (see Tables 3, 4, 5).

Each rater was asked to choose the "correct" or most nearly correct paragraph on the paired paragraphs for himself or for others.

Paragraph pairs *A* through *G* were used with Groups *A*, *C*, and *D*. Paragraph pairs *J* through *P* were used only with Group *B*.

TABLE 7
Distribution of the Fourteen Basic Patterns*

Pattern No.	Group *A*	Group *B*	Group *C*	Group *D*	Total
1	1	6	5	8	20
2	5	3	4	6	18
3	5	1	3	6	15
4	4	4	3	5	16
5	1	1	2	2	6
6	3	2	3	2	10
7	3	3	5	5	16
8	4	3	0	0	7
9	16	20	4	19	59
10	5	4	4	15	28
11	1	3	0	5	9
12	0	1	2	2	5
13	0	1	2	2	5
14	1	0	1	3	5
	49	52	38	80	219

*There are some interesting differences between the groups in pattern frequencies. Pattern 9 is known as the "leader" pattern, Pattern 10, as the "follower." An earlier study (3) showed no peaking at these points in a large "normal" sample.

At the Ivy League Campus, there are seven *S*'s with "Charm" Patterns (No. 8). These are absent in the other two samples. It would appear from Tables 9 and 10, that these differences have not affected this study. They are, however, suggestive of some interesting hypotheses. One suspects important social differences between campuses are being expressed here.

Table 8 shows a sample data collection or rating sheet, one of which was provided each subject for the purpose of recording his choices of most fitting descriptions for his associates, as well as himself.

F. Results and Discussion

Out of a possible 219 self-raings and 438 ratings of others, we obtained 204 self-ratings and 382 ratings of others. Table 9 shows the number and percentage of "agree" and "disagree" choices made where "agree" stands for the choices assigned as "true" by the experimenter being picked as accurate by the rater, and where "disagree" indicates number of times the "false" paragraph was chosen by the rater as accurately describing the ratee.

Table 9 contains also, the chi squares for differences between observed and chance expectations. It can be seen from the table that in all cases, the members of the group chose the paragraph assigned as "true" by the experimenter more frequently than they chose the "false" paragraph, as being an accurate description of the ratee. In all cases, the percentage of "agree" choices is higher than would be predicted on a chance basis.

The chi square determinations for these differences are significant for all groups and conditions, except for Group *C*. Here, the smaller size of the sample rather than any apparent difference in accuracy of choice (see Tables 10 and 11) seems to account for the lowered significance.

TABLE 8
SAMPLE DATA COLLECTION SHEET
(With illustrative responses)

INSTRUCTIONS:

Persons to be rated are listed below. For each, you will receive a sheet of paper with descriptions of two individuals. Read these descriptions carefully, then decide which description most nearly describes the person to be rated. Enter the number of that description opposite the person's name. The descriptions are general and will not describe the person specifically. However, you should have no trouble in making the decision as to which description is most like the person.

PART 1—RATING OF OTHERS

NAME OF SUBJECT	RATING SHEET TO BE USED	NUMBER OF THE DESCRIPTION CHOSEN AS BEST	CONFIDENCE OF SELECTION
1. Richard Roe	E	10	Very Sure ☐ Sure ☒ Not Sure ☐
2. John Smith	G	13	Very Sure ☐ Sure ☒ Not Sure ☐
3.			Very Sure ☐ Sure ☐ Not Sure ☐
4.			Very Sure ☐ Sure ☐ Not Sure ☐
	PART II—SELF RATING		
1. John Doe	D	4	Very Sure ☒ Sure ☐ Not sure ☐

Tables 10 and 11 compare choice frequencies between our four groups. Here, examination reveals no significant differences in accuracy of choice between groups. This is of special interest in that Group *D*'s ratings of others was possibly limited by virtue of brevity of knowledge of others (all were freshmen) and different pairs of paragraphs were used by Groups *A*, *C*, and *D*, from those used by Group *B*.

One may conclude that these heterogeneous groups all showed very similar responses in this task and that differences in test materials, length of

TABLE 9

NUMBER AND PERCENTAGE OF CHOICES BY SELF-RATERS AND ASSOCIATE RATERS WHICH AGREE OR DISAGREE WITH EXPERIMENTER'S DESCRIPTION CLASSIFICATIONS

	Group A			Group B			Group C			Group D			Total		
	Self	Other	Total	Self	Other	Total	Self	Other	Total	Self	Other	Total	Self	Other	Total
Agree	35 (73%)	64 (68%)	99 (70%)	33 (67%)	64 (65%)	97 (66%)	23 (64%)	42 (59%)	65 (61%)	48 (68%)	73 (62%)	121 (64%)	139 (68%)	243 (64%)	382 (65%)
Disagree	13 (27%)	30 (32%)	43 (30%)	16 (33%)	35 (35%)	51 (34%)	13 (36%)	29 (41%)	42 (39%)	23 (32%)	45 (38%)	68 (36%)	65 (32%)	139 (36%)	204 (35%)
Total	48	94	142	49	99	148	36	71	107	71	118	189	204	382	586
Chi Square	10.1†	12.3†	13.9†	5.9*	8.6†	14.3‡	2.8	2.4	4.9	8.8†	6.6†	14.3‡	26.8‡	28.3‡	54.1‡
Fourfold point Coefficient r_p													.36	.27	.32
Coefficient of Contingency C (Upper limit = .707)													.34	.26	.30

* = significant beyond .02 level.
† = significant beyond .01 level.
‡ = significant beyond .001 level.

TABLE 10

Comparisons of Right and Wrong Self-Choice Frequencies for Each Group With Frequencies Expected from Totals† of Remaining Sub-Group Combinations

Sub-groups	% Right	Right choices: Number right	Right choices: Expected number right	Wrong choices: Number wrong	Wrong choices: Expected number wrong	Chi square	P
A	73%	35	32.0	13	16.0	.843	Between .30 and .50
B	67%	33	33.5	16	15.5	.023	Between .80 and .90
C	64%	23	24.8	13	11.2	.420	Between .50 and .70
D	68%	48	48.6	23	22.4	.023	Between .80 and .90
Total	68%	139		65			

†Theoretical values were based on the following totals (excluding sub-groups of test):

Right: 104, 116, 106, and 91.
Wrong: 52, 52, 49, and 42.

TABLE 11

COMPARISONS OF RIGHT AND WRONG ASSOCIATE RATER CHOICE FREQUENCIES FOR EACH GROUP WITH FREQUENCIES EXPECTED FROM TOTALS† OF REMAINING SUB-GROUP COMBINATIONS

Sub-groups	% Right	Right choices Number right	Expected number right	Wrong choices Number wrong	Expected number wrong	Chi square	P
A	68%	64	58.4	30	35.6	1.418	Between: .20 and .30
B	65%	64	62.7	35	36.3	.074	Between: .70 and .80
C	59%	42	45.9	29	25.1	.937	Between: .30 and .50
D	62%	73	76.0	45	42.0	.332	Between: .50 and .70
Total:	64%	243		139			

†Theoretical values were based on the following totals (excluding sub-groups of test):

Right: 179, 201, 179, and 170
Wrong: 109, 110, 104, and 94

ratee knowledge, and campus environment did not significantly affect accuracy of choice.

Table 12 shows no significant difference between self-ratings and ratings of others.

TABLE 12

COMPARISON OF RIGHT VS. WRONG SELF-CHOICE INCIDENCE, AND RIGHT VS. WRONG ASSOCIATES' CHOICE INCIDENCE

Self choices		Associate choices	
No. right 139	No. wrong 65	No. right 243	No. wrong 139
% Total choices (p_1)	% Total choices (q_1)	% Total choices (p_2)	% Total choices (q_2)
68%	32%	64%	36%

Diff. $p_1 - p_2 = .04$. $\sigma D_p = .041$. CR = .976.
(not significant)

It is obvious that in arbitrarily classifying our subjects into one of 14 possible personality groups, injustices and inaccuracies crept in. No *S*'s were discarded, although many showed patterns that were difficult to classify accurately. One particular problem was that of "deviation." It will be obvious to the reader that the narrower a test profile, the less probable it is that descriptions based on the relative strength of the various profile components will be accurate. In addition, *AVA* profiles under 10 *T*-Scale Units are within the area of known Standard Error of Measurement of the Resultant Vectors.[2]

In order to assess the rôle played by profile deviation in judgment and to eliminate those *S*'s with possibly inaccurate profiles from consideration, all *S*'s records were classified for profile deviation. Accuracy of rating for different Profile Deviation groups are shown in Tables 13 and 14.

Chi squares for differences between observed and expected frequencies are shown in each case. It is clear that with increasing clearness or sharpness of test pattern, there is increased agreement between test based descriptions and rater judgment. Table 13 shows a significant biserial "*r*" of +.42 between Pattern Deviation and accuracy of self-choice, while Table 14 reveals a corresponding significant biserial of +.28. Why this may be so would seem to relate not only to possible measurement errors, but also to other intra-test variables.

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[2] Standard Error of Measurement = ±5 *T*-Scale units.

TABLE 13

COMPARISONS OF RIGHT AND WRONG SELF CHOICE FREQUENCIES WITH FREQUENCIES EXPECTED BY CHANCE WITHIN PATTERN DEVIATION* RANGES

Pattern deviation ranges of subjects' *AVA* profiles (*T*-scores)	% Right	Right choices		Wrong choices		Chi square	P
		Number right	Number right by chance	Number wrong	Number wrong by chance		
30 and greater	89%	32	18	4	18	21.778	.001
20 through 29	76%	48	31.5	15	31.5	17.286	.001
10 through 19	64%	47	37	27	37	5.405	.02
00 through 09	39%	12	15.5	19	15.5	1.581	.21
Total	68%	139	102.0	65	102.0	26.843	.001

*Pattern Deviation = The Maximum Vector *T*-Score minus the Minimum Vector *T*-Score in a particular profile. ($r_{bis} = +.42 \pm .05$ between Pattern Deviation and Right vs. Wrong Self Choice.)

TABLE 14

Comparisons of Right and Wrong Choice by Associate Frequencies With Frequencies Expected by Chance Within Pattern Deviation* Ranges

Pattern deviation ranges of subjects' *AVA* profiles (*T*-scores)	% Right	Right choices		Wrong choices		Chi square	P
		Number right	Number right by chance	Number wrong	Number wrong by chance		
30 and greater	76%	54	35.5	17	35.5	19.282	.001
20 through 29	69%	82	59.5	37	59.5	17.017	.001
10 through 19	62%	87	70.0	53	70.0	8.257	.01
00 through 09	38%	20	26.0	32	26.0	2.769	.10
Total	64%	243	191.0	139	191.0	28.314	.001

*Pattern Deviation = The Maximum Vector *T*-Score minus the Minimum Vector *T*-Score in a particular profile. ($r_{bis} = +.28 \pm .04$ between Pattern Deviation and Right vs. Wrong Choices of Associates.)

Where there is *AVA* pattern congruency between Columns 1 and 2, the patterns developed on Resultant will be approximately as "broad" as on Columns 1 and 2. Hypothetically, the greater the discrepancy between vectors, the more "colorful" and easily identified will be the person. Should the patterns be "tight" on Columns 1 and 2, it will be narrow on Resultant, and Clarke predicts then, that the person will be "colorless" and not sharply identifiable to others and, possibly, will be ambiguous to himself.

One other factor making for a "narrow" or "tight" deviation in the Resultant is a lack of congruence between Columns 1 and 2 Patterns. For example, should Column 1's pattern be a clear high V-1, low V-2, 3, 4 pattern and Column 2's pattern be the reverse; high V-2, 3, 4, and low V-1, the resultant will approach a straight line. This inter-column conflict represents lack of agreement between the social self (Column 1), and self of selves (Column 2), in the Jamesian sense. Where such conditions exist, one would predict a confused over-all self-picture and, possibly, sharp fluctuations in rôle-playing in inter-personal situations and, hence, low agreement as to self-characteristics or in ratings by others.

That this is precisely the case, is shown by Tables 13 and 14. As the person's test profile becomes sharper and more accentuated, the test becomes increasingly accurate. Where the test profile is very narrow, the results are poorer than chance, and probably reflect the conditions described above. If we now recalculate the data shown in Table 9 without those *S*'s whose Profile Deviations fall at or below 10 *T*-Scale (1.0 Sigma) Units, we find that the accuracy of choice increases greatly, as is shown in Table 15.

The highly significant Chi Square values indicate that the groups chose the "true" paragraph as being more correctly descriptive of the ratee far more frequently than chance and the null hypothesis, i.e., that the test had no descriptive value, is clearly untenable.

The fourfold point correlations shown in Table 15 show that the correlation between the choices made by raters and the classifications made by the experimenter from test profiles are of a magnitude indicating *AVA* Resultant Validity, at least as great, and probably higher than the obtained values.[3]

It seems safe to conclude that test-based profiles were judged as accurate significantly more often than chance by self-raters and in ratings of others in a variety of groups. It was further shown that when certain inherent test factors predictably making for difficulties in classification and

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[3] r_p is always lower than r_{bis} and product moment r's on similar data.

TABLE 15

NUMBER AND PERCENTAGE AGREE-DISAGREE RATINGS FOR ALL GROUPS ON *S*'S WITH PROFILE DEVIATIONS GREATER THAN 1.0 SIGMA UNITS

	Group *A*			Group *B*			Group *C*			Group *D*			Total		
	Self	Other	Total	Self	Other	Total	Self	Other	Total	Self	Other	Total	Self	Other	Total
Agree	32 (78%)	60 (69%)	92 (72%)	32 (73%)	62 (66%)	94 (68%)	22 (73%)	35 (64%)	57 (67%)	41 (71%)	66 (70%)	107 (70%)	127 (73%)	223 (68%)	350 (70%)
Disagree	9 (22%)	27 (31%)	36 (28%)	12 (27%)	32 (34%)	44 (32%)	8 (27%)	20 (36%)	28 (33%)	17 (29%)	28 (30%)	45 (30%)	46 (27%)	107 (32%)	153 (30%)
Total	41	87	128	44	94	138	30	55	85	58	94	152	173	330	503
Chi square	12.92	12.52	24.5	9.09	9.57	18.12	6.53	4.09*	9.89	9.93	15.36	25.29	37.92	40.77	77.15
												r_p	.47	.35	.39
												C†	.42	.34	.36

*Significant at .02-.05 level.

All other values of Chi Square obtained have values significant at or well beyond .01 level of confidence.

†Maximal value .707.

possibly in rating of behavior are analyzed out (Tables 13, 14, and 15) that accuracy rises even further.

It would appear that the *AVA* Test has good descriptive validity. It would also appear that descriptive paragraphs of a "canned" variety can be accurate and detailed enough to allow better than chance "recognition" of the person involved.

G. Summary

The descriptive validity of a temperament description-producing instrument, the Activity Vector Analysis, was assessed in four college samples with *N*'s of 48, 36, 71, and 49. A system of 14 score profiles with accompanying prototype temperament descriptions was used to provide paired descriptions, one classed as "right" by the experimenter, and one classed as "wrong" by the experimenter, for each subject. Choices between pairs of descriptions for subjects were secured from testees and associates. These were compared with the experimenter's classification of "right" and "wrong," and the obtained agreement of choices of "right" and "wrong" descriptions were compared with the chance-expected frequencies of choice. Evidence of descriptive validity was obtained and one controlling determinant of descriptive validity for this instrument was evaluated.

H. Conclusions

1. Significant descriptive validity for *AVA* resultant profiles was shown in choices between "right" and "wrong" descriptions by testees (Self-Judgment).

2. Significant descriptive validity for *AVA* resultant profiles was shown in choices between "right" and "wrong" descriptions by associates (Judgment of Others).

3. No statistically significant differences were found among the college sub-samples in any comparison of the accuracy of description choices.

4. No difference in results was obtained with distractor descriptions being opposite, $r = -1.00$, to the "right" description, rather than merely "not close," $r = .00$ or $-.33$.

5. Descriptive validity is significantly greater for wide deviation than for small deviation *AVA* resultant patterns.

6. The technique of demonstrating *AVA* descriptive validity through descriptions representing prototype score profiles was shown to be feasible.

7. This study investigated the descriptive validity of one portion of

AVA data. Further studies are desirable to measure the descriptive validity of other portions and of the totality of the *AVA* personality information.

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A NON-VERBAL APPROACH TO THE PHENOMENAL SELF*[1]

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A. INTRODUCTION

Allport (1) in 1943 called attention to the neglect of the "self" in contemporary psychology. Since that time a variety of techniques have been proposed for the examination of various aspects of the self ranging from simple requests for a self description to questionnaires and *Q*-sorts of verbal statements. Unsuccessful attempts to apply such direct verbal techniques to subjects other than intelligent normals, and theoretical doubts about such procedures led the writer to attempt to produce a less direct method making small verbal demands on the subject.

The present paper describes this technique and presents the results of its individual administration to 200 male subjects, normal, neurotic, and psychotic of a wide range of age, intellect, and verbal capacity.

B. ARGUMENT

There are several difficulties in the way of direct verbal techniques in self studies. As Hilgard (3) has pointed out: "defence mechanisms and self-deception so contaminate self-observation that unaided introspection is bound to yield a distorted view of the self." Frenkel-Brunswik (2) has demonstrated the nature of this distortion. Hilgard argued that we must attempt to devise less direct situations from which we might extract an "inferred self."

Another difficulty is the limiting character of the particular verbal symbols chosen by the experimenter for manipulation by the subject. There can be no assurance that a series of adjectives, important though they may be in the experience of a university student, will even remotely approach the important dimensions in the personal world of the mentally-disturbed to whom they may appear trivial, if not nonsensical.

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The subject, it is suggested, must somehow be presented with a highly flexible stimulus material from which he can shape his own unique scale. He must first of all be persuaded to make some behavioural declaration of the system or scale by which his important human judgements are made. Then he must be persuaded to demonstrate the position he feels he occupies on this unique, and possibly very unusual, scale.

While projective material would at first sight seem well suited to this task it is difficult to see how a single projective stimulus could elicit this amount of information.

Could we instead use a whole *collection* of ill-defined stimuli and have our subject order them into a continuum which has meaning and direction (at least for him)—which extends, let us say, from the "best" (howsoever personally defined) to the "worst." A series of vague ill-defined human portraits might be so arranged from the "best person" to the "worst person." If these faces were presented by Paired Comparison the resultant rank order might be compared with the orders resulting from other sortings of the same material—such as to questions relating to perceived likeness to the self. A high correspondence of "self" and "best" rank orders might then suggest that whatever positive qualities were projected into the stimuli were perceived as being possessed by the subject himself; whatever negative features were projected were rejected as unlike the self. By contrast a negative correlation between the rank orders would suggest a more unhappy view of the self. Would normals and suicidal depressives show differences on such a measure?

A number of further enquiries immediately suggest themselves: if the faces were sorted for "intelligence," for "attractiveness," for "dominance," or indeed for any other human quality, the relative similarities of these orders with the "self" order might indicate the relative extent to which the self was perceived as possessing these qualities. Again, the relative similarities of these three orders with the "best" order might indicate their relative valuation by the subject as desirable human attributes (or, in other terms, the relative extent to which they contributed to his "halo-donation system"). The similarity between a "self" and a "preferred friend" sorting might permit a tentative exploration of such factors as narcissism in friend choice.

The present paper will be confined to material relating to the "self" however, and the application of this method to the problems of object choice will be discussed in a further paper. There would seem to be no reason why this "multiple projective technique" should not be applied to many other attitude problems where it is desirable for the subject's own frame of reference to be "declared."

C. METHOD

Some 40 male portraits were presented informally and unsystematically to normals, neurotics, and psychotics for their comment. Seven pictures were finally chosen which evoked a wide variety of interpretations. These portraits were then diffused and distorted photographically, mounted on stout card (10 cm. x 7 cm.) and spiral bound into a booklet of two almost identical piles mounted side by side. The left hand pile was made up of Faces 1 to 6 and the right Faces 2 to 7. Thus each face could be compared systematically with every other by Paired Comparison (see Figure 1). Equivalent series for Females and Children were prepared.

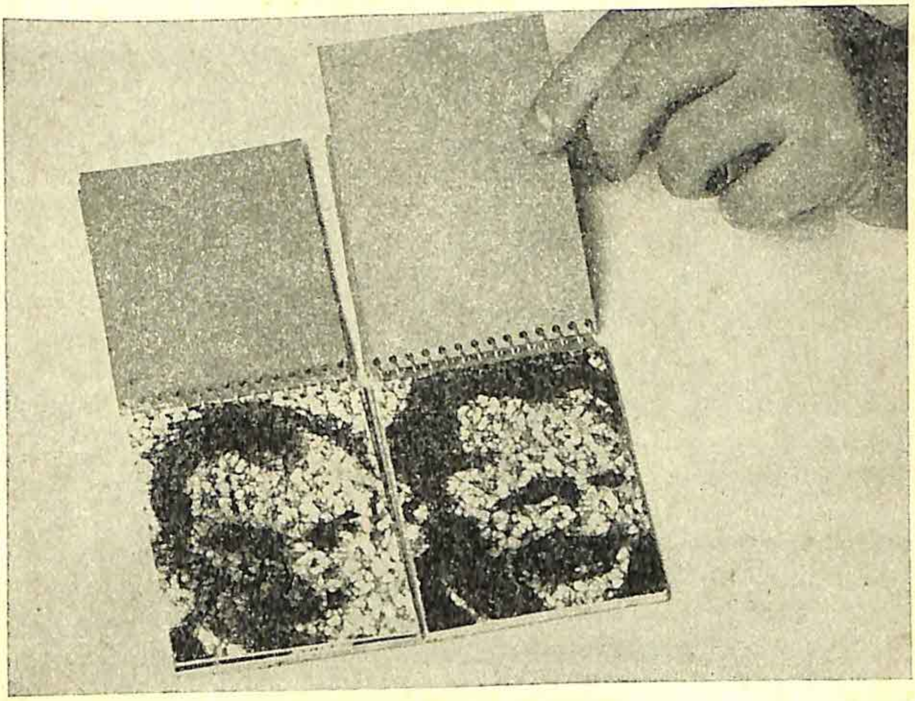

FIGURE 1

The test booklet was opened before the subject who was asked to indicate which of the Faces 1 and 2 was "probably the better person." In general at least half of all subjects responded to this inadequate question without protest. The majority of the remainder were usually satisfied by the further comment: "You can judge people; you have to show me which of those two is probably the better all round person." Card 2 on the right was then turned over so that 1 and 3 might be compared, and so on until 1 and 7 had been compared. Card 1 on the left was then turned over so that 2 on the left could be compared with 3, 4, 5, 6, and 7 on the right, and so on for the 21 comparisons (which usually occupied about three minutes). Then similar comparisons were made to each of the following questions:

> "Who is probably the more intelligent and clever person?"
>
> "Who is the more attractive person?"
>
> "Who is probably the more dominant person—I mean who would probably get his own way?"
>
> "Who is probably the more nervous and highly strung?"

Finally, in an approving atmosphere, in which his competence was beyond question, the subject was asked to point to the card of each pair which was "probably more like yourself *as a person*." The whole comparison procedure described usually occupied about 20 minutes. Choices, which were always approved by a nod or a word, were recorded as they were made in the appropriate cell of the framework of the record form (or on a simple scoring machine which threw out a rank-order directly).

Frequencies and rank orders were entered by inspection. The record form was carefully designed on two sheets* so that (*a*) the "Self" order and (*b*) the "Best" order could be readily compared with each of the other rank orders by superimposition of sheets. The sum of the $(\text{differences})^2$ for each comparison of orders was treated as a score and entered on a psychogram framework on the front of the record form which was designed so that rank correlation coefficients could be read directly from it and the "pattern" of all scores viewed at once. The total scoring time for five "self-scores" and four "value-scores" was, with practice, about three minutes.

Pursuing the argument that it was not "self-rating" on any attribute that was important so much as self-rating *in relation to* the particular valuation by the subject of that attribute, "discrepancy scores" were calculated between "self scores" and "value scores" for each dimension (by subtraction of Σd^2 values).

D. SUBJECTS

Tables 1 and 2 summarise the results of testing 50 normals, (mean age 37.2), 50 neurotics (mean age 39.1), 50 depressives (mean age 45.3), and 50 schizophrenics (mean age 34.8). The normals were members of hospital staff and older students who were selected by the writer after a brief interview. None had ever sought or received psychiatric treatment. All were unpaid volunteers. The diagnosis in the abnormal groups was always agreed by two or more psychiatrists. The majority of the depressives and schizophrenics were hospitalised cases. The neurotics were out-patients of this Department.

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*Materials published by J. & P. Bealls Ltd., Gallowgate, Newcastle-on-Tyne.

TABLE 1

"Self-Scores": Values of ΣD^2 From Differences between "Self" and Five Other Rank Orders

	S/B	S/I	S/A	S/D	S/N
Normal Mean	17.8	22.2	23.7	26.4	57.2
SD	9.2	12.4	14.2	16.4	22.7
Neurotic Mean	22.7	29.3	35.6*	72.2*	76.3*
SD	14.4	18.4	12.3	22.7	27.6
Depressive Mean	53.2*	40.6*	26.4	35.4	46.4
SD	19.7	15.2	12.3	11.8	24.6
Schizophrenic Mean	27.7*	30.4	28.6	32.7	35.7*
SD	14.7	21.6	20.3	22.3	31.2

*Difference from Normal Mean > 3 × *SE* of Difference.

TABLE 2

"Value-Scores": Values of ΣD^2 From Differences between "Best" and Four Other Rank Orders

	B/I	B/A	B/D	B/N
Normal Mean	15.4	26.7	28.7	72.6
SD	7.6	18.3	14.4	19.8
Neurotic Mean	19.6	17.9*	82.8*	67.3
SD	17.7	8.5	21.4	21.7
Depressive Mean	12.6	22.7	44.2*	63.4
SD	10.4	8.5	19.1	24.1
Schizophrenic Mean	36.3*	30.2	24.4	44.3*
SD	20.4	16.7	15.1	23.7

*Difference from Normal Mean > 3 × *SE* Difference between Means.

E. Non-Verbal Results

1. *Correlations With "Self" and "Best" Orders*

The non-verbal results are shown in the Summary Table which extracts the significant items from Tables 1 and 2.

The neurotics' "self"/"attractive" correlations of rank orders were higher than the normals'. At the same time their "best"/"attractive" correlations were higher than the normals'. Their "self"/"dominant" correlations were less than normal and their "best"/"dominant" correlations were considerably less than normal.

The depressives' "self"/"best" and "self"/"intelligent" correlations were less than those of the normal group. Their "best"/"dominant" correlations were lower than normal.

The schizophrenics' "self"/"nervous" and "best"/"nervous" correlations were greater than normal and their "self"/"best" and "best"/"intelligent" correlations lower than normal.

TABLE 3
Summary Table (Significant Entries of Tables 1 and 2)

	"Self" correlations		"Best" correlations	
	Greater than normal	Less than normal	Greater than normal	Less than normal
Neurotic	S/A	S/D	B/A	B/D (mean is negative)
Depressive		S/B S/I		B/D (mean is positive)
Schizophrenic	S/N	S/B	B/N	B/I

S = "Self," *B* = "Better," *I* = "Intelligent," *A* = "Attractive," *D* = "Dominant," *N* = "Nervous."

2. *Discrepancy Scores*

No significant differences appeared in discrepancy scores between the three abnormal groups and each other.

The discrepancy scores of the three abnormal groups taken together however were significantly greater than the normal discrepancy scores on all dimensions except "intelligence."

3. *Popularity of Picture Choice*

According to Szondi theory there should be a clear-cut preference for, or aversion towards, certain faces on the part of particular diagnostic groups. Records, both male and female, were inspected in both "self" and "best" categories. In one group only did a high popularity of choice appear; 42 out of 50 depressive females choosing Portrait 2 as the "best" person, the corresponding figure for normals being 18 out of 50.

F. Spontaneous Verbal Responses

Though it was not the original intention to seek verbal responses, the unusual character of many spontaneous verbal comments made early in the enquiry prompted their systematic recording. Thus after the paired comparisons were completed the subject was asked as each portrait was exposed separately "What do you make of him as a person?" (permitted elaborations: "What do you think of him?", "What is he probably like as a person?"). After all responses to this question had been recorded for each picture, the subject was asked to declare the probable age, occupation, and marital status of each. These last three questions added a wealth of interesting material showing the unexpected and unusual concepts employed by many subjects in their human judgements.

It was found useful to mark alongside the verbal responses the extremes of each rank order taken from the frameworks of the record form. Thus, responses to Picture 4 might be marked I the "most intelligent" and Picture 6 (—I) the "least intelligent."* Card 6 might also be marked *S* the "most like self" etc. Six specimen verbal records are given here (Table 4).

Table 5 lists the main categories of response and shows the frequency with which responses occurred in 17 such categories.

G. COMMENT

1. *Non-Verbal Results*

A loose interpretation of the non-verbal results might be as follows: neurotics valued attractiveness highly. Dominance by contrast was a "bad" human attribute. They felt they were themselves attractive but not dominant. They felt they were nervous.

Depressives similarly rated dominance a "bad" human quality but (unhappily) regarded themselves as dominant. They felt themselves low on intelligence. They felt they were less good than normals.

Schizophrenics felt themselves neither particularly good nor particularly nervous. They valued intelligence less than did normals and did not view nervousness as such a "bad" attribute.

There is no need to emphasise the caution which is necessary in viewing this interpretation of the results nor to stress the weakness of the simple psychiatric classification adopted in this enquiry. More work using much more refined nosological categories is required. It should be noted too, that the age of the depressive group was 8.1 yrs. greater than that of the normals. It might well be that lowered attention and vitality alone would increase the randomness of sortings and so reduce the correlations. It should be observed also that some of the precautions appropriate to Paired Comparisons experiments were necessarily omitted.

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*In practice a capital I etc., struck through diagonally has been used to represent "least intelligent" etc. but this cannot be set in type.

TABLE 4

Normal, female, age 20. Typist.		Neurotic male, age 19. Office worker.	
1) S_2 D	Simple person (perhaps because of the mouth) Moody person she looks . . . yes. (Schoolteacher, age 38)	1) B S_5	Can't make much of that one. I've tried hard! Just an ordinary person . . . no can't make much of him. Untidy looking. Age 25. Plumber.
2) D S_6 (—A) (—N)	A "horsy" type . . . tweeds. Quite intelligent I should think. . . . A man's job (keeps riding stable, age 46).	2) (—B) S_7 D (—A) I	Really unpleasant in everything—speech, actions—self-important, self-possessed. Age 32, author.
3) N. S_5	Just looks like a neurotic—those eyes! Long hair—nagging type. Don't like her very much. (Housewife, age 44.)	3) (—N) S_6	He's just about the same only more so—wouldn't trust him. Age 28, journalist.
4) S_4	Jolly type . . . parties and whatnot. Glamorous. Likes a good time. Flighty I should think too. (Glamorous job . . . waitress in night club, age 26.)	4) (—I) S_2 (—D)	Just one of a gang of . . . just following what everyone else does—tries to be bigger than he should be. Age 35, grocer's assistant.
5) S_2	Quite artistic looking . . . would like nice plays and nice books. Quite a nice person. (Works among books or sells pictures, age 26.)	5) S_4 N	Very sly and not forward, but undercover. Sly brain . . . ready to do anything underhand. Age 35, spy.
6) I A S_1 B	Very very timid . . . quiet, sorrowful eyes. Nice but very quiet. Librarian . . . even a typist. (An ordinary job. Age 22.)	6) S_1	Cold calculating . . . subtle in his activity . . . deep. Age 40, police.
7) (—I) (—A) (—B) (—D) S_7	She looks like Marilyn Monroe dyed blonde hair and out for a good time . . . dumb. (Film star, age 24.)	7) S_3 A	Just somebody smoking a cig. A bit suspect, potential thief. Age 25, shop assistant.

Schizophrenic, male, age 30.		Suicidal attempt, male, age 23. Fitter Turner, seaman.	
1) (—I) (—N) S_6	Typical gangster, coshboy, hoodlum.	1) S_2 (—A)	He's all right . . . a bit vague. Age 30, farmer.
2) B (—A) S_3	Like a ruthless killer by poison. . . . Like a doctor . . . acid and things like that.	2) S_3 (—D)	He's made a success out of life. Pretty intelligent. I suppose he's not perfect. Age 35, lawyer.

TABLE 4 (*continued*)

Schizophrenic, male, age 30.		Suicidal attempt, male, age 23. Fitter Turner, seaman.	
3) D S_2	Also like a doctor . . . killer . . . poisoner.	3) (—N) S_5 (—I)	Decent chap. Gets a laugh out of life. He can smile. Age 38, office-worker.
4) S_7 (—B)	Like a puncher, just a rough brawler . . . bad type.	4 S_6	Couldn't judge him—he's probably a decent worker. He has his own way of life just as anybody else has. Age 35, mechanic.
5) A N S_5	This one sir . . . yes . . . vicious like a sly cunning type.	5) I B D S_7 A	He's intelligent. He can instruct people. He's got a grip on what he's doing. Knows how to go about things. Built his own strength of character. Age 40, teacher.
6) I (—D) S_4	Also like a doctor . . . surgeon . . . more like the casino gangsters . . . surgeon.	6) S_4	I suppose he gives people something to smile at. His intelligence should be good. Age 32, engineer.
7) S_1	Like a street corner brawler . . . not a bad looking character but he is tough. . . . Any old iron would do . . . any weapon sort of style.	7) (—B) N S_1	All depends what he's doing. Might be caught in an attitude. Don't like look in his eyes, somehow. Too interested in the ladies. Age 25, cook.
Involutional depressive, male, age 54.		Paraphrenic, male, age 61.	
1) S_7 B I	He's all right . . . he's in a deep study there. He takes things seriously. Age 60, lawyer.	1) S_3 D (—N)	Wouldn't like to say he was much as a person. More a rogue than anything else. Not a genuine person, by his expression. King of rogue kind of man. Couldn't put too much faith in him. He would murder. Works in a public house, handling the barrels. Age 70.
2) (—D) S_4	Jolly chap, concentrating . . . he's all right. Age 50, workman.	2) I A S_1	Well, I would say I wouldn't like to trust that man either, yet he's intelligent but I don't like him, a deceiving kind of man. I'm not far off the mark. My father could read a man as well. I'm good at reading a man. He could do a clerk's job—the criminal type for all his glasses. Age 50.

TABLE 4 (*continued*)

Involutional depressive, male, age 54.			Paraphrenic, male, age 61.		
3)	S_1 D	He's all right. If you had a problem to solve . . . he'd try to solve it. Age 55, Minister.	3)	S_4 B	A criminal, not to be trusted. So much of deceivery, would twist you, you know by the look of her. More like a woman. Would not put too much trust in her. He might not be a murderer but would be deceiving. No job of any importance, for example—packing. Age 51 or 2.
4)	A S_6 (—N) Ix	He's hard-thinking . . . he's studying there. He looks after his appearance. Popular with the girls. Age 45, salesman.	4)	(—D) (—I) S_7 N	I wouldn't trust that man either because of his appearance. Seems to me to be more of the criminal type—he's got a cunning eye in his head. He's a murderer type, like a criminal. Don't know who would ever give him a job—ha, ha. A criminal, he would have a job behind bars.
5)	S_5	He's studying as well . . . nice chap . . . looks very pleasant . . . could talk to you . . . make you feel comfortable. Age 58, Manager.	5)	S_2	That man is a cunning man as well. Wouldn't put no trust in that man. Puts me in mind of that Christie that was hanged.† He's a murderer. (He's a Christie type—a deceiver. Has a job of bit of consequence — travelling job—selling. Age 45 or 46.)
6)	(—B) S_2	He would talk to you . . . he'd converse all right. Age 60, office-worker.	6)	S_5	I wouldn't put no trust in this man either by their expressions:—kind of a Rogue —you can always tell anyone genuine by their expression. He would murder. More like a circus clown—no one would employ him. Age 50.
7)	(—A) N S_3	Peaceful . . . he could explain things to you. Age 70, retired teacher.	7)	(—B) (—A) S_6	Well, I wouldn't trust him either. They're men not to be trusted. Look more like criminals than anything else. He would commit murder. Not much of a job, just a rough and ready job. Age 50.

†Recent English murder case.

TABLE 5

VERBAL RESPONSE FREQUENCIES IN 17 CATEGORIES

Category	Example	Norm.	Neur.	Dep.	Sch.
(1) Physiognomic	(a) Simple ref. to "nice eyes," "ugly nose."	9	12	19	5
	(b) Grooming: "he doesn't look after his hair"	1	24	11	3
(2) Social Level	"He's just a lower class fellow . . . a servant"	6	4	1	2
(3) Intelligence	"A bright capable fellow"	161	103	54	13
(4) Achievement	"Built himself a business"	28	37	12	8
(5) Occupation	"Looks like a bank clerk"	174	109	32	24
(6) Moralistic	"A good living man," "a bad type," "evil"	76	136	31	140
(7) Killer	"A poisoner with acid . . . a doctor"	0	0	5	46
(8) Sexual	"Looks a bit too keen on the ladies"	2	4	22	11
(9) Parasite	"He doesn't pull his weight . . . a waster"	1	6	21	9
(10) Dominance	"He'd stand no nonsense"	11	28	34	14
(11) Authority	"Father" "boss" "police" "judge"	9	15	10	42
(12) Relationship with self	"He'd be friendly and easy to get on with" "He would help you"	43	61	93	14
(13) Neuroticism	Attribution of nervousness or lack of . . . "He looks an edgy . . . moody sort of person"	23	126	50	27
(14) Intention	"He looks as though he's going to do something desperate"	0	0	2	34
(15) Unusual	"He looks like an unemployed cricketer"	0	1	13	42
(16) Naïve self	"That's me!"	0	0	0	9
(17) Don't know	"It doesn't seem like a face . . . more like rocks"	7	25	21	22
Other responses		27	69	12	39
Totals		578	760	433	504
Responses per record		11.56	15.2	8.66	10.08

2. *Discrepancy Scores*

The discrepancy scores evidently distinguish abnormals as a *group* from normals as a *group*. The utility of this separation in *individual* cases can only be shown by further enquiry.

3. *Popularity of Picture Choice*

It is interesting that only one instance of high popularity of choice should occur (the depressive females' choice of Portrait 2) and yet that the degree of popularity should be so high within that group. The particular "female" depicted is one seen by many normals as a rather dominant, masculine individual of bespectacled, intelligent appearance typically labelled as a librarian or schoolmistress of young middle age.

4. *Verbal Results*

The verbal results show promise, but the perennial weakness of such methods—the subjective classification of responses—remains. Nevertheless the relatively clear-cut nature of some responses such as the "killer" response (which appeared at least once in 62 per cent of schizophrenic records), the "intention" response (in schizophrenics), the "sexual" response (surprisingly prominent in depressives), and the "grooming" response (in neurotics) were sufficiently clear-cut to offer hope as a diagnostic aid as well as suggesting interesting theoretical possibilities.

The majority of subjects, both normal and abnormal, seemed pleasantly flattered to be asked for their judgements about people and the method has shown itself to be successful in getting *some* useful response in the most unpromising situations and in securing material relevant to the most diverse problems.

In volume at least the material readily produced by the comparing and contrasting of this series of vague distorted portraits seems greatly in excess of that produced by more conventional single-stimulus methods. Though the technique outlined certainly appears useful in its present form, and merits careful standardization, it clearly offers many opportunities for variation of instructions and freer and less controlled investigation of the personal world. But, most important, it seems to offer a method for the systematic study of the mechanisms which subserve, in Snygg and Combs' terms (4) Man's most consistent need "the maintenance and enhancement of the phenomenal self."

H. SUMMARY

In an attempt to avoid some of the practical and theoretical difficulties of verbal approaches to the self a 30-minute "Self Valuation Test" was designed which required only that the subject should point to one of two pictures. The test, which was administered to 200 subjects (normal, neurotic, and psychotic) was based on the successive orderings, by Paired Comparisons, of a series of seven vague, distorted human portraits. Comparisons were made for "the better person" for intelligence, attractiveness, dominance, nervousness, and for likeness to the self "as a person." The rank orders set up in this way were compared with one another.

Significant differences were reported, such as the lower than normal "self"/"best" correlations of depressives and the negative "dominance"/"best" correlations of neurotics.

Popularity of portrait choice as between diagnostic groups was studied to test predictions from Szondi theory.

Though planned as an exclusively non-verbal technique, spontaneous verbal responses were produced which assumed great interest and possible diagnostic significance. Thus "he's a killer" appeared in more than half the schizophrenic records.

The possible application of this "multiple projective technique" to other attitude problems, including that of object-choice was mentioned.

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ON FIELD FORCES*

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A. INTRODUCTION

Although a number of authors have called attention to field forces, the concept has found no place in motivational theory. It is the purpose of the present paper to describe a method of demonstrating field forces and to indicate their importance for a psychology of motivation.

The term "field forces" is here used to refer to motivational forces arising from parts of the psychological field other than the individual. Since the concept has not found general acceptance, I shall start with a brief discussion of it and with examples of the operation of field forces.

Köhler (10) has pointed to the necessity for distinguishing between the locus and the reference of experiences. While all experiences presuppose physiological processes in the *organism*, they need not all refer to the *self*; their reference may be to the perceived environment. As Asch remarks in a discussion of this distinction (2, p. 292): "All experiences are, to be sure, mine, but only a small fraction of them refer to me; I am right to locate my toothache in my body and to locate my country outside it."

Wertheimer (12) and Asch have applied this same distinction to problems of motivation. Motives, like other psychological processes, presuppose physiological events in the individual's nervous system; their locus is thus the organism. But they *may* refer to parts of the psychological field other than the ego; forces may arise from the experienced requirements of a situation, of persons and events outside the self. For the sake of convenience, the latter forces will be designated field forces, while the term ego forces will be applied to those motivational forces arising in the person.[1]

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[1] Actually both terms are misnomers. The ego is, of course, part of the psychological field. Thus the name "field forces" is an abbreviation for the expression "forces arising in the psychological field exclusive of those arising in the person." Again, it cannot be assumed that all motivational forces arising in the person are ego forces in any precise sense; much of our motivation stems from parts of the person which are not ego. Since, however, even these forces require the coöperation of the ego for their expression, and since their reference is to the person, the term "ego forces" will be extended to include them. Perhaps more accurate terms would be "field-referent forces" and "ego-referent forces."

Field forces seem to be important in the initiation of behavior whenever we feel that there are situations which call for action, as contrasted with those in which *we* need to act. For example, the response to the request from a stranger, "Got a match, bud?" is one in which the person acts to meet the requirements of a perceived situation rather than those of an existing ego need. Or we right an object which is about to fall. Again, we say that a person or a scene compels our attention, that a man needs help, that an activity attracts us. We think of a person as caught in the web of circumstances.

In all these cases the forces that initiate action seem to arise mainly from the perceived circumstances. It must be understood, however, that where field forces are operating (as also, of course, in the case of ego forces) both personal and environmental conditions are involved in the determination of behavior. Where forces arise from the demands of a situation, these demands must be perceived by the individual, and his resources must be brought into play in their service. A situation may cry out for action, but if this cry falls on deaf ears, or on the sensitive ears of a person incapable of acting, there will be no action (cf. 7). Illustrations of the ways in which demands of the field must be related to those of the self to be effective will be given below.

Thus the operation of field forces, as of ego forces, presupposes not only a rôle of the experienced situation in the determination of behavior, but also a rôle of the person (forces from the ego as well as the non-ego in the person, as also his abilities, attitudes and resources). But the important point is that the rôle of each is different in the two cases. This difference is of considerable interest for theory. Where ego forces are primary, the rôle of the environment is to provide incentive objects and means and barriers to the satisfaction of the person's needs. In instances in which field forces initiate action, if we are to believe our phenomenal experience, it is not mainly the ego that uses its surroundings; it seems, rather, to lend itself to them.

Although phenomenal experience argues eloquently for a rôle for field forces in the initiation of behavior, there have been a number of reasons for its neglect:

1. First, it must be admitted that this experience is ambiguous. For example, social and objective interest, interest in the people, things and events in the world around us, seems to offer some of the most convincing evidence that forces may arise from parts of the psychological field outside ourselves. But such facts have been handled by the assumption of a grega-

rious need, a curiosity drive, a need for understanding, and the like. Such an assumption presupposes, of course, that the forces in question refer to the person. Again, a heroic act of self-sacrifice to rescue another may be saved for the hedonistic principle by the supposition of the prospect of reward in heaven; or else masochistic or other unconscious tendencies may be held responsible.[2]

While other difficulties with this kind of solution will be mentioned below, it may be stated here that it does no more than to push the problem to a different level. As has been pointed out elsewhere (8), even if all motivational forces are viewed as referring to the individual, it is still important to distinguish between those ego forces in the service of a situation and those in the service of the individual (cf. also 2, p. 318).

2. A second reason for the neglect of field forces is that special relations quickly become established between the individual and the incentive object or activity. Take a case in which we may assume that an object or activity attracts the individual: the object quickly becomes transformed through the person's occupation with it (8). For example, a scientist undertakes a particular line of work because he sees that certain issues remain unsettled; let us suppose that he has no other stake, conscious or unconscious, in the problem. Soon it becomes *his* problem: criticism of the work may become criticism of him, etc. So it is when we form sentiments. A system comes to be established including the needs both of the individual and of the object. The relations between field forces and ego forces will be discussed more specifically below. The point of present interest is that the fact that such relations are quickly established obscures the question of the source of the action.

3. Perhaps the most compelling reason for the neglect of field forces is that it has not been possible in research to separate them from ego forces. It is scarcely possible to set up in the laboratory situations whose demands are so compelling that the person is caught up in them regardless of his own needs. In the typical experiment on motivation a need or intention is aroused in the subject to perform some activity. The activity or the experimental situation may have particular demands of its own, demands which would produce certain effects. But these cannot be separated from the

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[2] Of course, instances of behavior which appear to go against the interests of the ego are not, in themselves, evidence that field forces have initiated the behavior. In the present example, there may indeed be neurotic reasons for the sacrifice, or some other need of the ego may be stronger than self-preservation. It cannot be established in advance, without intimate knowledge of the circumstances, that any particular act is predominantly in the service of the ego or predominantly in the service of the situation.

consequences of the need which had to be aroused to get the individual to participate in the experimental activity in the first place. Not only does the *task* need to be done (a field force); the *individual* needs to do it (an ego force). With the interrupted task technique, for example, the subject both perceives the interrupted activity—perceives that the demands of the task have not been met—and is himself interrupted. Heretofore it has not been possible experimentally to separate these two kinds of demands. Of the two kinds of forces operating in such a situation, ego forces alone have received adequate attention, in accordance with current theory. The requirements of the task have been overlooked. (The importance of the perceived demands of a task for its resumption has been suggested elsewhere; cf. 8.)

B. THE OBSERVER TECHNIQUE

Before a strong case can be made out for the importance of field forces for motivational theory, it seems necessary to be able to demonstrate them. To this end it is necessary to separate the two kinds of motivation—field forces and ego forces. For this purpose the "observer technique" has been devised.

In the "observer experiment" one individual—we will call him the observer (*O*)—merely watches a subject performing a series of tasks, but is not himself permitted to participate. The performing *S* is known little or not at all to *O*, so that the latter has no personal interest in *S*'s successes and failures. If, now, some of the tasks are interrupted, then in the case of *O* there will be operating essentially no forces deriving from his own needs to complete the tasks, only forces deriving from the perceived incompleteness of the activities (or the perceived lack of satisfaction of *S*'s need)—that is to say, only field forces. If these latter are important in the determination of behavior, then *O* should show such effects of interruption as the superiority of incomplete tasks in recall (13) or increased attractiveness of the interrupted activities (4). On the other hand, if it is the unsatisfied (ego) need which is responsible for these effects, incomplete tasks should be treated no differently from completed ones by *O*.

Experiments performed under the conditions described have shown that *O*s do recall incomplete tasks (i.e., tasks which *S* has had to leave unfinished) better than completed ones (3). Furthermore, when offered a choice among tasks similar to those which they have just seen *S* performing, they choose tasks like those on which *S* has been interrupted significantly more often than chance; the attractiveness of the interrupted tasks has been enhanced for the *O*s.[3] Some force must exist which favors the interrupted tasks in the case of the *O*s. The forces responsible must arise from *O*'s cognitive grasp of the experimental situation. Since his own needs are not primarily involved—since he is not interrupted nor allowed to complete tasks, and since he himself runs no risk of failure—ego-referent forces cannot be mainly responsible for the obtained differences between interrupted and completed tasks. The results speak, rather, for the operation of field forces.

It might, of course, be argued that seeing *S* fail in an activity may play into an *O*'s own deep-seated feelings of insecurity, and that his choice of the interrupted task represents an effort to cope with the aroused anxiety. While the experimental situation minimizes such a possibility,[4] it cannot be eliminated in all cases. But even in such cases it must be remembered that the forces responsible for the effect include field-referent forces arising from the perceived failure, which coöperate with tendencies in *O* himself. Again, it might be held that *O* identifies with the (unknown) *S*, and that his ego needs are thus vicariously involved. This seems to me to be begging the question. We hardly seem to have gained in understanding by subsuming the observer effect under the little understood processes of identification and empathy. On the contrary, the observer technique seems to offer the possibility of some day investigating these very processes.

C. RELATIONS OF FIELD FORCES AND EGO FORCES

Since the experimental isolation of field forces has been stressed, it must now be repeated that, except under the most artificial experimental conditions, field-referent forces operate always in conjunction with ego forces. Although the specific relations between the two kinds of forces require investigation, we may begin to describe some of the ways in which they operate in relation to each other.

1. Certain essential demands of the person must be met before there can be any real turning outward of interest. In other words, a certain level of satisfaction of ego needs is necessary before the individual can respond to field forces. An impressive illustration is found in Sir Ernest Shackleton's account of his effort to reach the South Pole (quoted by Leeper, 11, p. 26):

> "During the last weeks of the journey outwards, and the long march back, we really thought of little but food. The glory of the great mountains that towered high on either side, the majesty of the enormous

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[3] A later paper will report a first demonstration of the effects of field forces.

[4] Since the experiments are concerned with the effects of interruption, not of failure, cases of obvious failure are eliminated from the tabulated results.

> glacier up which we travelled so painfully, did not appeal to our emotions to any great extent. . . ."

Practically the whole imaginative life of semistarved men may thus be preoccupied with thoughts and fantasies about food and eating; and there is no reason to think that the situation is different in the case of the emotionally starved.

In this same connection an observation of Asch's is pertinent (2, p. 304): "In a developed individual the presence of a coherent ego is a necessary condition of action; the carrying out of complex actions requires a knowledge of and a reference to the self."

2. Under usual conditions there seems to be a genuine coöperation between field forces and ego forces, the one reinforcing the other. Take, for example, the question of ethnic prejudices. A good deal of recent investigation has looked for personality correlates of such prejudices, for example displaced hostility; in other words it has looked to ego forces for an explanation. On the other hand, we may not forget that a stereotype or image of the minority group exists in the culture. If the group really possessed the characteristics attributed to it, one could not help disliking its members. And similarly, if a person unthinkingly accepts this cultural image, he cannot help disliking the group. In other words, forces making for the prejudice may arise from the cultural image of the minority group as well as from tendencies in the prejudiced individual's personality; we must consider field forces as well as ego forces.

For the sake of argument let us grant both positions. Suppose, now, that we have established in a given case that displaced aggression is responsible for the prejudice. It will still be true that the individual finds some particular target for his hostility rather than some other one; he hates the minority group instead of kicking his dog. Thus forces arising out of the properties of the cultural image coöperate with his own tendency. Or we may find that a person unthinkingly accepts the cultural image of the minority group, which image is then the principal source of the forces responsible for the prejudice. But it is still worth investigating whether he may not find something in the image to hate in particular—so that forces in himself coöperate with those arising from the (here wrongly) perceived object.

Indeed, so close is the coöperation between field forces and ego forces that it is perhaps more accurate to speak of two aspects of all motivation rather than of two kinds of forces.

3. Again, conflicts may arise between the demands of the ego and those

of the field.[5] Conflicts between pleasure and duty may be (but need not be) of this kind.[6]

4. A special case in which field forces and ego forces are in opposition is that in which the one blinds the person to the requirements of the other, so that no conflict is experienced. For example, an individual may be so involved in a personal problem that he cannot attend properly to his work, or he misses an appointment, or he may be immune to other demands of the field. Or else one may be so caught in an activity that legitimate ego needs may be neglected. For example, we read until too late, not because we want to continue reading, but because we cannot put the book down. In a very important sense, it is the book that holds us, not we who hold the book.[7]

D. Field Forces in a Theory of Motivation

If we incorporate the concept of field force into a theory of motivation, several problems seem to be simplified, and others appear in a different perspective. The enormous diversity of adult human motivation has presented difficulties to need or instinct theories as well as to *S-R* accounts (cf. 1). Likewise Allport's solution of functional autonomy of motives (1) has not escaped criticism, and different interpretations of the evidence Allport adduces in support of this doctrine have been suggested (2, p. 343 ff.). The concept of field force offers another solution to this problem. It proposes to deal with the tremendous variety of human motivation in terms of properties of force in the perceived objects and events outside the self. It seems difficult to account for our specifically appropriate response to the request "Got a match?" in terms of a gregarious propensity or a need for affiliation or nurturance alone. But if this request itself is perceived as eliciting forces which coöperate with tendencies in the individual, the difficulties seem to disappear.

This example suggests another, closely related question whose solution

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[5] Of course conflicts also exist between various personal forces as well as between simultaneously active field forces.

[6] It is important not to confuse the present problem with a moral one, although the considerations discussed here have application to questions of ethics (9, 12). To distinguish between the needs of the person and the requirements of the situation does not imply that the former are selfish. Not everything in the interests of the person is egotistical. The concept of field forces carries no implication that these should take precedence over ego forces. The opposite is equally often the case. And there are instances in which the needs of the person are the most important objective requirements of the field (cf. 2, p. 312 f.).

[7] In this example, it will be noted, forces from the field blind the reader to certain personal needs, but require the coöperation of others. Thus the absorbing book must be absorbing to *him*.

is facilitated by the assumption of field forces: the question of how specific or how inclusive a segment of activity to employ in our concept of needs. Are we to invoke a need for offering matches to account for the corresponding action? It was seen above that a gregarious need does not account for the specificity of the behavior. But if we regard needs as specific enough to account for each act, we have lost the advantages of a need theory in bringing order to the diversity of behavior. Again the concept of field forces offers a third alternative which seems to avoid the difficulties of the other two. Specificity is introduced if perceived objects and events of the environment possess the attributes of force; and we can retain a concept of need inclusive enough to organize the data of behavior.

In the study of field forces we are investigating forces arising from the cognitive appreciation of the situation confronting the individual. This is one aspect of a much larger problem, that of the cognitive side of motives and emotions in general. Motives and emotions are not purely irrational; they have their cognitive aspect as well. This problem has been raised by Wertheimer and carried farther by Asch; elsewhere it has been fairly generally neglected. Nevertheless I believe this point is implicit in every theory of motivation and affect. It is implicit in every theory that takes for granted a certain appropriateness of the emotion to the situation in which it arises; it is silently contained in every view that speaks of pathology where this appropriateness is lacking.[8]

This general problem of the cognitive aspect of motives and emotions has been neglected for precisely the same reason that our particular problem of field forces has been neglected: it has been impossible to separate the affective aspect of the experience from the cognitive. At the same time that the individual perceives the situation confronting him, something is happening to him. It may be that we are now in possession of a conceptual tool and a method which will permit investigation of this larger problem.

Finally, the concept of field forces suggests a new view of certain problems in the phenomenology of motivation—an area of problems that seems to have got lost in the interest in unconscious motivation. I mentioned earlier that common experience is ambiguous as evidence for the initiation of action from the field. It must now be added that there is a further ambiguity. At times we incorrectly refer the source of action or experience to the experienced situation or to the self. The concept of projection in part describes cases of the first kind; for example, self-rejection may be translated into rejection by another. Conversely, an experience may erroneously be referred to the self; to use a parallel example, rejection by an important person may be translated in part into rejection by the self. The facts described as introjection and identification are relevant in this connection. In dealings with others we may erroneously take or assign credit or blame. How are we to understand these instances? If they are simply errors in locating the source of motivational forces—if the reference of our phenomenal experience to ourselves or to the perceived surroundings is not to be relied on—it might be argued that much of the case for field forces collapses.

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[8] Cf. Anna Freud (5, p. 42): ". . . We expect children normally to react to these particular occurrences with these specific affects. But, contrary to expectation, observation may show us a very different picture. For example, a child may exhibit indifference when we should have looked for disappointment, exuberant high spirits instead of mortification, excessive tenderness instead of jealousy. In all these cases something has happened to disturb the normal process. . . ."

Actually, these are probably limiting cases, and are probably not simply errors in the reference of an experience. We need to know more of the psychological processes involved before the bearing of these instances on the present problem will become clear. Meanwhile, it seems safe to say that both field forces and ego forces are operating in all these cases and that, in ways that still have to be understood, their interaction results in errors of emphasis.

In the case of projection, except in the most extreme instances, we are probably never dealing simply with an incorrect view of the sources of forces. There may be, rather, an over-sensitization, because of a problem in the individual, to something that actually exists in the other. We do not project at random.[9] (The incorrect emphasis on the field forces in these instances remains, of course, to be explained. If an ego need can blind us to the requirements of the field, there is no reason why one cannot blind us to other forces in the person.)

The case of erroneous reference to the self is at present more difficult to understand. Two directions of thinking suggest themselves. First, while a force originating outside the self may be referred to the self, its outside reference may also be present. If the rejection by the other is translated into self rejection, this need not obscure the original rejection. It seems plausible, then, that intervening cognitive processes may account in part for the new reference of the experience. The rejection by the other may lead to a search for and emphasis upon the deficiencies of the self. Or it may play into existing feelings of self-rejection.

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[9] Cf. Freud (6, p. 236): "We begin to see that we describe the behavior of both jealous and persecuted paranoiacs very inadequately by saying that they project outwards on to others what they do not wish to recognize in themselves.

"Certainly they do this; but they do not project it into the sky, so to speak, where there is nothing of the sort already. . . ." (Cf. also 5, p. 130.)

Perhaps a more significant, but more obscure, point in the same connection concerns the nature of relations. The other person represents, fulfills, brings out, reflects or in some way "fits" part of the individual. The other is not simply an outer figure, but an inner figure as well (one who corresponds more or less closely to the outer one or to aspects of the outer one) if he is to stand in these relations to the self. Thus it seems likely, in our example (though the processes involved are by no means clear), that rejection by the other *is* rejection by the self. The same issue is seen more clearly in cases involving projection: we may refuse to have anything to do with a person who appeals to, supports or in some way represents a part of ourselves that we will have nothing to do with. Here rejection of the (suitable) other is rejection of part of the self; again ego forces and field forces are at work.

The same kinds of considerations seem to apply even more obviously to the example of the wrong assignment of credit or blame. In joint undertakings responsibility probably never lies only in the self or only in the (objective) other.

We have been dealing in these examples with one aspect of the problem of how we experience our own motivation—viz., the reference of forces to the person or the field. With this as a starting point, other aspects of this problem may become clear. For example, *A* and *B* have a falling out. *A* considers *B* responsible, while *B* thinks that an outsider, *C*, made the trouble between them. Each may then structure the relevant facts of the case about his own view of the reference of the difficulty, so that the two may come out with entirely different versions.

E. SUMMARY

It has been suggested that it is time to revise current ego-centered theories of motivation to give a place to field forces, those motivational forces arising from the experienced requirements of situations and persons outside the self. A method of demonstrating field forces, the observer technique, has been described, and some of the relations between field forces and ego forces have been indicated. The place of the concept of field force in a theory of motivation was discussed. The assumption offers a new solution to the problem of the diversity and specificity of human motivation. In addition, it provides one approach to the neglected problem of the cognitive side of motivation and emotions. Finally, certain problems of the phenomenology of motivation were discussed in the light of the concept of field force.

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SIMILARITY OF VALUES AND ITS RELATION TO ACCEPTANCE AND THE PROJECTION OF SIMILARITY*

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A. INTRODUCTION AND PROBLEM

Within the past few years several studies in the field of group dynamics have been concerned with the relationship between actual or perceived similarity and dissimilarity among persons and the extent to which they accept and reject one another. From evidence reported in the literature it seems reasonable to believe that the extent to which another person is thought to agree with one's judgments is related to the extent to which he is accepted by one (6). Persons will perceive those whom they like best as being more similar to themselves than those whom they like least (3). Congenial individuals perceive one another as being more alike than do individuals in conflict (10). Finally, the degree of actual similarity between individuals as expressed in their value judgments is related to (*a*) the extent to which they accept or reject one another (8, 9), (*b*) the amount of benefit they perceive themselves as capable of extending to and receiving from one another (11), and (*c*) the level of social sensitivity they attribute to one another (4).

All of these studies share a common fault of field research: they are purely correlational studies and it is not possible to distinguish between independent and dependent variables. Causal relations are hopelessly obscured.

The present investigation was undertaken in part to clarify this problem. Specifically, it was proposed to investigate the hypothesis that the extent to which a person sees another as resembling himself in consequential aspects will determine at least to some degree the extent to which he will accept that person.

In the paper by Precker (9) cited above, evidence is offered for the existence of what he refers to as the automorphic process in the attribution of values. He describes this process as one by which "we tend to attribute to objects of our choice those characteristics which we ourselves possess and those

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valuings which are characteristic of ourselves." The evidence that is offered concerns only one level of acceptance, i.e., the person *most* accepted by the subject within the context of the study. It is conceivable that the automorphic process is operative independently of the variable of acceptance. The relationship between level of acceptance and the extent of the automorphic process remains unexplored.

The second hypothesis tested in the present investigation concerns itself with this problem. It states that the degree to which one person accepts another is related to the extent to which he projects his own values on that person.

B. PROCEDURES

1. *Subjects*

The subjects in this experiment were 28 sophomore and junior students who were enrolled in an undergraduate course in personality. Sixteen were men, 12 women. All of the members of the class participated in the research with the exception of one student who had previously been involved in a similar experiment. At the first meeting of the class it was announced that all members of the class would be obliged to participate in psychological experiments as part of their course work. They were asked to fill out a form giving such information as phone number and time free for research.

2. *Value Judgments*

The Revised Allport-Vernon Scale of Values was selected as a test instrument which required judgments on matters that were of genuine concern to persons and should thereby be appropriate for the testing of the hypotheses.

This test was administered to the subjects as part of their regular class work. They were told that the tests would be scored and returned later in the semester when the topic of value orientation and personality would be discussed. Within the next week the test booklets were scored by research assistants.

On the basis of the answers provided by each subject two experimental test booklets were assembled. These were partially completed Revised Allport-Vernon test booklets from which had been systematically excluded all information concerning the scale on which the subject received the lowest score. One form contained entries identical with those recorded by the subjects; the other involved entries derived so as to yield a constant degree of dissimilarity. A description of the procedure follows:

a. Similar test booklet. In Part I of the test booklet, all items involving the crucial value scale, the one on which the subject received the lowest score, were left blank. On all of the remaining items, the subject's original scores were duplicated. In Part II of the test booklet any item that did not involve the crucial value scale was completed as the subject had completed it. For all other items partial information was provided. If the subject had originally assigned the rank of 1 or 3 to the crucial value, the ranks 1 and 3 were not filled in and the ranks 2 and 4 were recorded in the same way the subject had recorded them. If the subject had originally assigned the rank 2 or 4 to the crucial value, the ranks 2 and 4 were not filled in and the remaining two ranks were entered in the same way the subject had entered them.

b. Dissimilar test booklet. In Part I of the test booklet, no entries were made for items involving the scale in which the subject received the lowest score. For all the remaining items, entries differed from the original answers by two points. If the subject had given the values of 3 and 0 to the two choices in his original test booklet, the values of 1 and 2 were now assigned; 2 and 1 were replaced by 0 and 3; 1 and 2 by 3 and 0; 0 and 3 by 2 and 1. In Part II of the test, items not involving the crucial value scale were completed with ranks reversed, i.e., the ranks 1, 2, 3, and 4 were replaced by the ranks 4, 3, 2, and 1. For all other items, partial information was again provided. In those instances in which the crucial value originally received the rank of 1 or 3, the ranks 1 and 3 were not entered and the ranks 2 and 4 were entered so that the original entries were reversed. For example, if the original rankings were 1, 2, 3, and 4 and the rank 3 or 1 had been assigned to the value on which the subject scored lowest, the entry in the experimental booklet would be —, 4, —, 2. A similar procedure was followed for the case in which the rank 2 or 4 was originally assigned to the crucial value. In this case an original ranking of 1, 2, 3, 4 would be replaced by 3, —, 1, —.

The advantage of this system of deriving partially completed similar and dissimilar experimental test booklets was that the degree of similarity and dissimilarity was identical for all subjects.

When the experimental test booklets were available, subjects were phoned, reminded of their obligation to participate in psychological research, and asked to appear at a specified time. Subjects were then tested individually or in small groups.

Instructions. The following instructions were read to the subjects:

> In our everyday life it is necessary for us to make judgments of other

> people on the basis of partial information. By knowing what they are like in some respects, we estimate other characteristics of theirs that we have not directly experienced.
>
> *In this study we shall ask you to do just this.*
>
> You will be given a test booklet like the one you filled out in class. In it you will find recorded some of the answers given by another person. We should like to have you study this information and develop an impression of what the other person is like. When you do have a fairly clear impression of the other person, will you please complete the test booklet, answering all of the questions in the way in which you feel that person answered them. When you have finished, every part of the test booklet should be completely filled in.
>
> There will be a total of two test booklets for you to complete. Each one has come from a different person. Remember that you are to get an impression of the other person before you complete his test booklet.
>
> We realize that this is a difficult task and that no one will be able to answer all of the items in the same way that the other person did. Just do as well as you can.
>
> Take all the time you need, and be sure that all empty spaces have been filled in. When you complete the first test, lay it aside and begin on the second test.
>
> If at any time you have questions, I shall try to answer them.

3. *Measures of Acceptance*

When the subjects had completed their test booklets, a graphic rating scale was provided on which they were required to rate the two hypothetical individuals with respect to willingness to associate with them under different circumstances. The instructions for the first ratings read:

> On the basis of your impression of these individuals, will you please describe your willingness to associate with each of them in a social (leisure-time) activity.
>
> You may place a single check at any point along the line that seems best to describe your reaction to each individual.

Five reference points were provided on each scale: very unwilling, unwilling, indifferent, willing, very willing.

The instructions for the remaining item read as follows:

> If you had to work with someone on a task or problem, how willing or unwilling would you be to work with each of these persons?

Similar scales were provided.

Subjects were than questioned concerning their reactions to the experiment, their interpretations, confusions, etc. Only one subject noticed that one of the test booklets resembled her own.

C. Analysis and Results

1. *Similarity and Acceptance*

Scores were derived from the rating scales by measuring the distance in millimeters from the left end of the scale to the point along the continuum at which the check mark was placed. High values represented high degrees of acceptance. For each subject two such values were obtained for each scale: one for the hypothetical dissimilar person, one for the hypothetical similar person. The difference between these two measurements (the score for the hypothetical similar person minus the score for the hypothetical dissimilar person) represents the degree to which the similar individual is preferred as an associate. The mean of the difference scores for the subjects was computed for each of the acceptance dimensions and the significance of this difference from zero was then determined. The results are summarized in Table 1.

TABLE 1
Subjects' Ratings of the Differential Acceptability of Similar and Dissimilar Individuals as Work and Leisure-Time Associates

Criterion	Mean Difference	σ_M	*CR*	*P*
Leisure-time associate	29.4	7.29	4.03	$<.001$
Work associate	21.25	7.81	2.72	.007

It can be concluded from this information that difference in ratings of the acceptability of individuals is a consequence of the rater's perception of differences in the degree to which these individuals share his values. The extent of this effect can be more easily comprehended if it is pointed out that the entire continuum extends from 0 to 129. The mean difference of 29.4 represents a difference equivalent to approximately one-fifth of the entire possible range.

2. *Acceptance and Projection*

In order to test the second hypothesis it was necessary to determine the extent to which the subject projected his own values onto similar and dissimilar individuals. This was accomplished by scoring both the experimental test booklets completed by the subjects. The only value scale used was that for which the score was completely determined by the subject: the crucial value scale on which he had originally received the lowest score. As a result, three scores were available for each subject on this crucial scale: (*a*) his original score; (*b*) that derived from the blank for the similar individual; and (*c*) that derived from the blank for the dissimilar individual.

A variable defined as the absolute difference between the first and second scores would be an inverse measure of the amount of similarity projected onto a hypothetical similar individual. Furthermore, the absolute difference between the first and third scores would provide a measure inversely related to the amount of similarity projected onto the dissimilar person. A test of our second hypothesis would be provided by correlating criteria measures of acceptance (leisure-time and work) with each of these measures. The results of this analysis are presented in Table 2. Extent of projection is seen to be significantly related to extent of acceptance as measured by either criterion within the similar group. The relationships between these variables are in the same direction for the dissimilar group but are not significant.

TABLE 2
CORRELATION BETWEEN AN INVERSE MEASURE OF AMOUNT OF PROJECTION AND EACH OF TWO CRITERIA OF ACCEPTANCE FOR HYPOTHETICAL SIMILAR AND DISSIMILAR INDIVIDUALS: RANK ORDER COEFFICIENTS ARE PRESENTED WITH SIGNIFICANCE VALUES IN PARENTHESES

Criterion of acceptance	Group analyzed Similar	 Dissimilar
Leisure-time associate	—.43	—.26
	(<.05)	(.17)
Work associate	—.53	—.25
	(<.01)	(.19)

Further clarification might be obtained by determining whether subjects who make the greatest distinction between the hypothetical similar and dissimilar individuals in terms of amount of projection also make the greatest distinction in terms of the amount of acceptance expressed. A measure of the tendency to project greater similarity onto similar individuals than dissimilar individuals would be provided by the quantity

$$\left|\text{Score}_{\text{own}} - \text{Score}_{\text{dissimilar}}\right| - \left|\text{Score}_{\text{own}} - \text{Score}_{\text{similar}}\right|$$

A measure of the second required variable was described in the beginning of this section. It is obtained by determining the differences between the acceptance values assigned to the two hypothetical individuals. This procedure can be used for each of the acceptance variables.

The relationship between differences in projection and differences in acceptance with respect to leisure-time and work activities are presented in

Table 3. The results indicate that differences in similarity as perceived by the subject (and expressed through his projections) are positively related to differences in acceptability.

TABLE 3
THE RELATIONSHIP BETWEEN DIFFERENCES IN THE EXTENT OF PROJECTED SIMILARITY AND DIFFERENCES IN THE DEGREE OF ACCEPTANCE: RANK ORDER CORRELATIONS AND CORRESPONDING PROBABILITY VALUES

Criterion of acceptance	ρ	P
Leisure-time associate	.57	.003
Work associate	.40	.03

D. DISCUSSION

One of the purposes of the present investigation was to study in the laboratory under controlled conditions variables previously observed in the field so that some clarification of their causal relationship might be achieved. It has not been clear from the numerous studies cited whether acceptance engenders similarity, or similarity gives rise to acceptance, or similarity and acceptance are determined by some other undefined variable(s) or whether some combinations of these relationships might exist.

In order to determine whether or not similarity gives rise to acceptance, completely hypothetical individuals were created who could be known only through a series of their value judgments. The subjects' knowledge of these hypothetical individuals could not extend beyond these statements. It is not known whether the subjects explicitly recognize the variable of similarity and dissimilarity but it is perfectly clear from the results that they react in a systematic way to these differences by being more acceptant of similar than dissimilar individuals. Acceptance in these circumstances can only be attributable to similarity.

Once differences in acceptability are established we find related to them differences in the extent to which additional similarity is projected. The dynamics of this process of projecting similarity cannot be described at the present time. It might well arise as an immediate consequence of the subjects' perception of the actual resemblance between their own judgments and those presented to them in the partially completed test booklets, i.e., the identification of similarity gives rise to the kind of process toward cognitive closure described by Precker (9). It is also possible that the variable of acceptance serves as a most important intermediate variable. For example, this response to similarity in values might have the dynamic qualities of a decision as described by Lewin (7), so that the result of decision-making is a genuine change in the configuration of own and induced forces. Answers to questions such as these must remain speculative until new information is accumulated.

However, it might be profitable to examine the results of this investigation in relation to one aspect of the theory of interpersonal relations developed by Heider (5). We shall refer specifically to the triadic relationship in which for our purposes one element is the person *p* (the subject), another is the person *o* (hypothetical individual) and the final one is the act *x* (value judgment as expressed by an answer on the Revised Allport-Vernon). Two kinds of relations among the variables will be considered: an evaluative relationship of the nature of like or dislike (accept or reject), and a unit relation of the type person *o* is associated with act *x* (the hypothetical person states *x* on the Revised Allport-Vernon). The possible patterns of relationships among these variables and their consequences have been described by Heider and elaborated by Cartwright and Harary (2), and need not be treated in this discussion. One of the relationships that concerns us is the following, $(p\ L\ x,\ o\ U\ x)$ which is to read as "*p* likes *x* and *o* is associated with *x*. No relationship exists between *p* and *o* at this point. Heider hypothesizes that under these circumstances there arises a force of such a nature as to achieve a balanced state. A balanced state will exist if the condition $(p\ L\ o)$ is established so that the total situation will be $(p\ L\ x,\ o\ U\ x,\ p\ L\ o)$.

If we now examine our experimental procedure we find that we have confronted our subject with the situation $(p\ L\ x,\ o\ U\ x)$. That is to say, our subject has already answered an item on the Revised Allport-Vernon in a particular way and he perceives the hypothetical similar individual as having answered it in the same way. This generates a force in the direction $(p\ L\ o)$. As he examines each answer of the hypothetical similar individual he finds the same conditions exist $(p\ L\ x,\ o\ U\ x)$. Therefore, in each instance the tendency toward $(p\ L\ o)$ is strengthened and the final result would be expected to be $(p\ L\ o)$.

When the subject examines the partially completed blank of the hypothetical dissimilar individual, the situation that exists is $(p\ L\ x,\ o{\sim}U\ x)$, or *p* likes *x* and *o* is not associated with *x*. The resolution of this disequilibrium could be accomplished by achieving the condition $(p{\sim}L\ o)$ which states that *p* does not like *o*. Again there is a tendency toward balance and a force in the direction of $(p{\sim}L\ o)$ arises. It is not certain whether our subjects were expressing rejection or indifference in assigning low weights to items on the value scale. Therefore, it is not certain whether the relationship to be predicted between p and o is one of dislike or indifference. However, we should predict from these considerations that the subject would be more acceptant of the hypothetical similar individual than the hypothetical dissimilar individual.

These predictions are confirmed in the analysis of the first hypothesis. It would be revealing to note that the average rating assigned to the similar individual on each of the acceptance scales is equivalent to a judgment "willing to associate." The average rating for the dissimilar individual corresponds to a judgment of "indifferent."

Turning to the phenomenon of projection of similarity we find that Heider's conceptual scheme is equally relevant. We have reasoned above that the process of examining the partially completed test booklet establishes a relationship between the subject and the hypothetical individual. When the subject attempts to predict the answers of the hypothetical similar individual, the conditions that exist are $(p\ L\ o,\ p\ L\ x)$. This presumably generates a force of the nature $(o\ U\ x)$ which will have the result of establishing structural balance. We should predict that p will attribute to o values identical with or resembling his own.

When the subject is required to complete the booklet of the dissimilar individual, he either rejects that person with the result $(p\ L\ x,\ p{\sim}L\ o,\ o{\sim}U\ x)$ or he is indifferent to the person and there is no force generated to produce either similarity or dissimilarity. An examination of our data indicates that the latter explanation is more tenable. The average Revised Allport-Vernon scale value projected onto the dissimilar individual is 39.82. Allport, Vernon, and Lindzey (1) report that the mean scores on each of the scales for 1816 college students range from 39.59 to 40.34. This result is consistent with our finding that on our two acceptance-rejection scales the average rating assigned to these individuals corresponds to the judgement "indifferent."

E. SUMMARY

The present study was undertaken to examine the causal relationship between the perception of similarity in value systems and acceptance and to explore the relationship between acceptance and the projection of similarity.

The subjects were 28 students in an undergraduate course in psychology. The Revised Allport-Vernon Scale of Values was administered as part of the regular class work. On the basis of each student's answers, two partially completed experimental test booklets were prepared. One was designed to be identical with the student's original answers. The other was systematically dissimilar. The subjects were asked to study these

partially completed test booklets, form an impression of each of the hypothetical individuals from whom the sets of answers were presumably derived, and then complete each test booklet in the same way they believed these individuals had.

Ratings were then obtained of their acceptance of these hypothetical individuals with respect to two criteria: as leisure-time or work associates.

Analysis of the results revealed that the following hypotheses had been supported:

1. The extent to which a person sees another as resembling himself in consequential aspects will determine at least to some degree the extent to which he will accept that person.

2. The degree to which one person accepts another is related to the extent to which he projects his own values on to that person.

A causal relationship was established with respect to the first hypothesis.

The experimental situation was analyzed in terms of the conceptual system developed by Heider. It was shown that the results obtained in this experiment could be predicted on the basis of Heider's theory.

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A NOTE ON CONCEPT ATTAINMENT*

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A. Problem

This note reports in brief the results of an experiment on concept-attainment, essentially similar in design to that reported by Heidbreder as Experiment *A* (1, 2).

The subjects were 17 Japanese students in the Tokyo University of Education, 13 men and 4 women. Nine concepts were studied, seven of which were the same as seven of those studied in Experiment *A*. The other two were based on symbols familiar to Japanese students: one, the Japanese symbol for post, post-office, etc.; the other, a swastika which in Japanese symbolizes Buddhism and Buddhist temple, but which some subjects responded to as a symbol for Nazism. The nonsense syllables used to name the concepts were taken from materials standardized for meaningfulness by Umemoto and others (3).

B. Procedure

The procedure was the same as that used in *A*, with the following exceptions, the first two of which were necessitated by the available apparatus.

1. The exposure time for each drawing was three seconds, not four seconds as in *A*.

2. Brief intervals occurred between the exposures of successive drawings within a series, whereas no such intervals occurred in *A*.

3. The criterion for mastering each series was a single errorless performance for that series, not two successive, errorless performances, as in *A*.

4. The experiment was terminated for each subject when he had correctly responded to two successive series on the first presentation of the drawings, whereas in *A* all subjects responded to all 16 series.

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[1] This experiment was part of the research for a thesis submitted to the Faculty of Psychology, Tokyo University of Education, in partial fulfillment of the requirements for a degree. The writer expresses his thanks to Dr. Edna Heidbreder for her coöperation in editing this note.

C. RESULTS

The results, summarized in Table 1, conform closely to those obtained in *A*. The outcome, as indicated by *CA* (concept attained), presented in the last column of this table, was that, as in *A*, concepts of concrete objects were attained first, concepts of spatial forms next, and concepts of numbers last. There was no exception to this rule. Furthermore, within the category of spatial forms, concepts of familiar forms were attained earlier, as in *A*, than concepts of unfamiliar forms.

TABLE 1
SHOWING, FOR THE CONCEPTS LISTED, THE MEANS ACCORDING TO THE MEASURES INDICATED
($N = 17$)

Concepts	First series	Main period		
	P (1)	*P* (*m*)	*FCA*	*CA*
Rena (face)	3.59	2.18	3.06	3.29
Waho (tree)	4.12	2.53	3.53	3.71
Royu (○)	4.29	2.41	3.00	4.18
Kene 卐	4.77	4.00	3.12	4.24
Hise (⁖)	5.35	4.18	3.47	5.00
Tauso (-◆-)	4.65	4.59	4.06	5.82
Homi (·●·)	4.88	7.12	4.71	6.77
Muta (5)	3.00	5.94	4.82	6.94
Nime (4)	7.93	9.35	5.41	8.12

For the other measures, too, the results were essentially the same as those obtained in *A*. The order indicated by *CA* was approximated by *FCA* (first correct anticipation) and *P* (*m*) (prompts during the main period), both of which measure performances during the main period—i.e., the period during which the conditions for the attainment of the experimental concepts were present and when conceptualization was presumably occurring—whereas that order was not indicated by *P* (1) (prompts during the first series), a measure of performances that occurred before those conditions were present.

Again as in *A*, the *t*'s indicated that for *CA*, *FCA*, and *P*(*m*), inter-category differences between the means for the various concepts were, as a rule, though with exceptions, significant at the 5 per cent level of confidence, whereas intra-category differences between means were as a rule, also with exceptions, not statistically significant. The exceptions, as in *A*, occurred for the most part in inter-category differences between the means of concepts of concrete objects and of familiar spatial forms, and in intra-category differences within the category of spatial forms, where the means for concepts of familiar and of unfamiliar forms were frequently separated by statistically significant differences. For P (1) the t's also followed the pattern of those in A, indicating that both inter-category and intra-category differences between the means for the concepts were, in the great majority of cases, not statistically significant.[2]

These results are presented as confirming those of A, and as possibly having some cross-cultural significance, though the cultures involved are similar in some respects and though neither culture has been uninfluenced by the other.

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[2] The complete data on the statistical significance of the differences discussed in this paragraph may be obtained from the writer of this note, or from Edna Heidbreder, Wellesley College, Wellesley 81, Massachusetts, U. S. A.

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THE INITIAL PERCEPTION OF PULSES OF LIGHT*

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A. PROBLEM

A number of investigations (1, 2, 3, 4, 5, 6, and 8) have shown that the activity of the cortex in response to optical input is not simple but that there are certain features of that activity which bear an obvious relationship to patternings of the stimulus energies. The result has been the formation of the "alternation-of-response" theory of flicker (3, 4, and 6). The present study is designed to investigate the implications of this theory for visual perception. It is hypothesized that, under controlled observation, the initial perception of pulses of light will have characteristics similar to those of the electrical record from the optic cortex at the onset of a train of pulsations of stimulating energy (1).

B. METHOD

Apparatus was constructed which permitted the repetitious presentation to the eye of a circular patch of light in an otherwise dark field. The intensity of stimulation, frequency of presentation, and number of repetitions were all controlled. The light period was fixed at 1/36th of the total cycle. With the author as observer, a number of trains of pulses were observed. These varied independently in length and intensity. Four levels of intensity were used, each with trains of 2, 3, 4, and 5 pulses. In any one session, the intensity was graduated from weak to strong so as to avoid adaptation effects, but otherwise, the order of presentation was random. In each instance, the observer initiated a train of pulses and immediately recorded the appearance of the resulting percept, together with the rate of pulsation, intensity, and train length. A number of trials were run with frequencies varying from very low rates in which the percept was one of isolated flashes to those giving fusion of the train. Such trials were run until every train length had been paired with every intensity at least five times.

C. RESULTS

A complete presentation of the results may be found elsewhere (11). In general, it may be said that the results were in line with the hypothesis:

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even at low rates of pulsation where the flashes were sufficiently distinct to be counted, there was observable variation in brightness of the flashes with the first very often, but not always, brighter than the rest. As the frequency became higher, the number of observed flashes dropped below the number of pulses presented. It was not always possible to say which flash had thus "dropped out," but analysis of the records shows that the second pulse in a series frequently began to lose effect at quite low frequencies, and its disappearance could sometimes be traced in successive records. Flicker was also noted on occasion, but its appearance was highly unpredictable. It seemed more likely to appear at the higher frequencies. One series was inadvertently repeated after an interval of two weeks. No differences due to lapse of time or to practice were found.

Perhaps the most interesting single aspect of the result is presented in Figure 1 where it may be observed that the fusion frequency of the train was found to be related not to the intensity of the stimulus but to the train length. The term "fusion" ordinarily seems to be used to refer to a kind of temporal resolving power of the retina or the cortex (12) though, as Landis has pointed out (10), there is still no completely comprehensive theory to account for the phenomenon. According to the "alternation-of-response" theory, the reason that intensity is not a determining factor (with the short trains used and within the limits of these intensities) is that with increasing length of train within the period of the "reorganization" of the parallel pathways from retina to cortex into functional, alternating groups as demanded by the theory and indicated by the physiological records from the optic nerve and cortex (1, 2, and 8), the number of elements (pathways) capable of responding fluctuate in part with intensity but also in part independently so long as this "reorganization" is going on. Therefore, as the train lengthens, the probabilities become greater that the additional pulses will find pathways that have recovered and are ready to be stimulated. Thus, in order for fusion to occur, as the length of the train increases, the frequency of pulsation would have to increase. This would hold so long as the recovery period of the pathways was fairly constant from time to time. There is evidence (8) that this is so.

D. Discussion

In terms of the "alternation-of-response" theory, fusion may be said to refer to the fact that the pathways from retina to cortex have been spread so thinly throughout the temporal pattern of stimulation that very few are responding to any one pulse. This means that at the cortex, stimulation is occurring diffusely (in the spatial sense) to each pulse, and that the effects from pulse to pulse are arriving so rapidly that to all intents the effect is the same as with steady illumination. If it is assumed that the cortex operates with a very rapid on-off action, fusion then represents simply a lower limit to continuity in visual experience. Brightness would depend upon the number of pathways responding together as well as the rapidity of firing in the pathway. Crozier has already, in different terms and in a different context, made this assumption (9). The fusion found in the present study represents a special case as does that found by Basler (7).

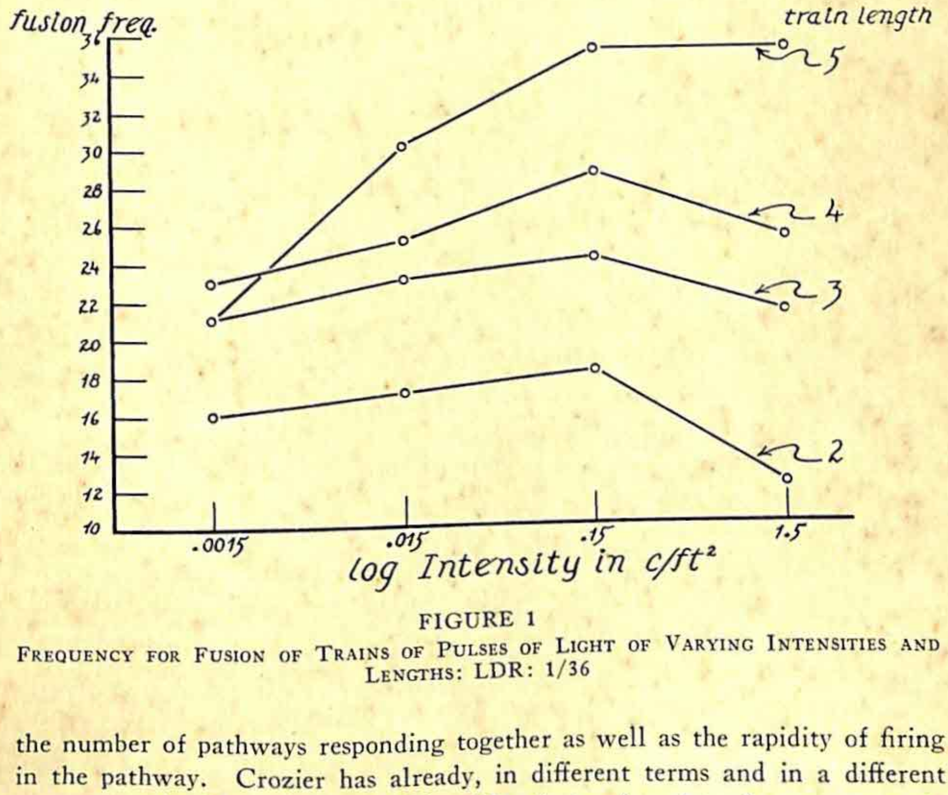

FIGURE 1

Frequency for Fusion of Trains of Pulses of Light of Varying Intensities and Lengths: LDR: 1/36

The foregoing represent a radical departure from the idea that fusion is determined by the photochemistry of the retina. However, the variability of the perceptual response observed in the present study and the general features such as the failure of the second pulse and the dependency of fusion upon length of train more than upon intensity of light are seen to support the "alternation-of-response" theory of the flicker fusion phenomenon.

E. SUMMARY

Apparatus was constructed to permit application to the eye of trains of pulses of light of given intensities, frequencies, and numbers with a fixed light-dark ratio. The resulting perceptual phenomena were recorded, and certain qualitative and quantitative aspects of these phenomena were discussed with a view toward integrating them into the body of the "alternation-of-response" theory of flicker perception. It was concluded that the phenomena observed were those to be expected from the theory and from the phenomena exhibited by the optic cortex as recorded electrically during similar stimulation of the receptors. The observed perceptual phenomena could not be accounted for by photochemistry.

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PERSEVERATION IN SCHIZOPHRENIC AND BRAIN DAMAGED PATIENTS*[1]

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A. INTRODUCTION

An adequate description of the way in which schizophrenic thinking differs from the normal has not been achieved. The search for differences is made more difficult because normal thinking is neither well understood nor its limits as yet defined. Indeed, experimental study of circumscribed deviant modes of thinking, clearly ascribable to schizophrenic impairment, is rendered difficult by the varied nature of the effects of psychopathologic emotion and the great disparity in populations utilized by various investigators in terms of the types of schizophrenic patients, length of hospitalization, and the acuteness and chronicity of the illness.

Several aspects of thinking impairment are under study in this laboratory. One of primary concern is the problem of perseveration or the inertia of mental functioning, which is stated by Spearman to be a unitary and independent dimension (9), an assertion subject to question by later work (1, 2). The law of inertia (perseveration) assumes importance since Spearman related psychological inertia to Gross' secondary function (3) or a kind of central refractory period following the primary activity. In Gross' typology, the personality characterized as schizoid would be seen in the individual showing an intense primary function, or neural excitation, corresponding to the arousal of a conscious content, and with an unconscious persistence of the functional excitement for a prolonged period. During this latter phase, the after-function would influence subsequent associative processes. Jung, in turn, equated the type with long secondary function to the introvert of his dichotomy (5).

Accordingly, in a study recently completed by Brown (1), the hypotheses were concerned with the inertial effects postulated to occur differentially between schizophrenic and brain damaged patients on tests presumed to measure sensory, ideational, and motor perseveration. While the brain damaged

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[1] From the Department of Psychiatry, Cornell University Medical College, The New York Hospital (Payne Whitney Psychiatric Clinic), and Hunter College.

patients showed significantly high perseveration in all areas, schizophrenic patients were not different on any test from matched controls, and intercorrelations did not suggest a single factor of perseveration.

As part of the larger study of thinking impairment referred to above, one of the authors (CAK) devised a special choice reaction time technique which is designed to measure inertia by means of a serial situation in which one response follows upon another of the same kind as closely as the after-effects of the previous response will permit. Prolonged after-effects of the response just made presumably delay or interfere with the succeeding reaction and would be shown as lengthened reaction times. The present experiment, using this procedure, was run concurrently and on the same patient population as that of the study by Brown cited above.

The larger problem is based on the assumption, for the time being, that Spearman's cognitive laws are independent and represent all cognitive dimensions to be found (op. cit.). If schizophrenic thinking and thinking in the brain damaged differ from normal, differences should be found along one or more of the stated dimensions. This study is concerned with variation along the dimension of mental inertia. For present purposes, a general and unitary dimension of perseveration, as stated by Spearman, is assumed. Since it cannot be shown that the present test is clearly motor, sensory, or ideational, but rather involves all three in the interaction of input, output, and central processes, lag anywhere in the system should be reflected in an increased time of reaction.

This study is therefore a direct attempt to verify the presence of the often reported increased perseveration in schizophrenic patients, using a new test designed to give inertial effects an opportunity to become manifest whether they are asserted through defective alerting, the failure to maintain a set, a loss of volition, or whatever function contributes to a lowered ability to run one behavior efficiently behind another. As can be seen, no attention is given here to sorting out the kinds of perseveration, if there be such. The intent was to bracket any and all perseverative effects by a single measure.

B. METHOD

1. *Subjects*

Three groups of patients numbering 15 in each group were obtained from The New York Hospital, the Payne Whitney Psychiatric Clinic, and Bellevue Medical Center.[2] These groups were matched for age and vocabulary achievement while keeping educational and socio-economic levels as comparable as possible.

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[2] Acknowledgments and additional details regarding these groups will be found in a previous report (1).

The control group was composed of 14 in-patients and one out-patient, convalescent from medical or surgical treatment and without history of neurological or psychiatric disorder. An equal number of schizophrenic patients included three in-patients and 12 out-patients unequivocally diagnosed as schizophrenic. None of these patients had experienced long term hospitalization or were in a state of dilapidation.

The group of 15 patients with diffuse brain damage was made up of 13 in-patients and 2 out-patients. Only patients whose diagnoses were clear were used. In addition, none of these patients represented chronic care cases at the time of examination.

2. *Apparatus and Procedure: Series Choice Reaction Time*

In performing the task, the subject stood before a sloping panel upon which were three lights spaced 20 inches apart and located at the corners of a base-down equilateral triangle. Toward the center of the triangle and adjacent to each light were three corresponding buttons spaced 11¼ inches apart.

A relay system was arranged in such a manner that when the starting button was depressed by the experimenter, the first light appeared on the panel. By pressing the button adjacent to the panel light then on, the patient caused that light to be extinguished and simultaneously one of the two other lights to be lit. Now, the subject was required to press the button corresponding to this second light, again with the result that one of the unlit lights simultaneously flashed on as this second light was extinguished. The sequence ran for 20 responses and was terminated when the last response produced a dark board. The order of lights was random within a sequence, and different random orders were constructed for succeeding sequences. It should be noted that each response in the series involved a choice situation. Either alternative involved an equal distance through which the hand was required to move in order to make the next response.

The sequence of lights and responses were recorded simultaneously for the three board locations on an Esterline Angus Operation Recorder with external rapid paper feed controlled by a synchronous motor and suitable gear reduction. The speed chosen was ¾ of an inch per second since response time is considerably longer than for conventional choice reaction. Individual reaction times were measured from the chart under magnification to the nearest .02 inch and then were converted to time units relative to chart speed. The first of the four sequences was considered a practice run so that the individual data represent the means of 60 responses for each test session measured from the second, third, and fourth sequences.

Each patient was tested on two occasions approximately one week apart, the second test being scheduled within the latitude of hospital routine.

C. Results

There are several findings of import shown in Table 1. Here the group means for the first and second run are shown separately for each experimental group along with the variability of the groups. The most striking result is the highly similar mean reaction time for controls and schizophrenic patients on both runs. At the same time, the increase in reaction time by the brain damaged over the control values approximates 40 per cent in each run.

TABLE 1

Reaction Time and Variability by Group Shown Separately for First and Second Test Sessions

Groups	Mean reaction time (Seconds)		Standard deviation (Seconds)	
	1st Run	2nd Run	1st Run	2nd Run
Control	.81	.77	.07	.08
Schizophrenic	.80	.76	.07	.06
Brain damaged	1.13	1.07	.35	.24

TABLE 2

Wilcoxon's Unmatched Pairs "*T*" Test

1st Run			2nd Run		
Groups compared	Sum ranks	P	Groups compared	Sum ranks	P
Brain damaged—schizophrenic	325.5 139.5	<.01	Brain damaged—schizophrenic	331.5 133.5	<.01
Brain damaged—control	324.5 140.5	<.01	Brain damaged—control	326.0 139.0	<.01
Control—schizophrenic	236.5 228.5	>.05	Control—schizophrenic	241.5 223.5	>.05

Using Wilcoxon's unmatched pairs "*T*" test (7), it was found (Table 2) that the probabilities of the differences in ranks obtained when the brain damaged were compared with the schizophrenics and controls respectively were significant at less than the .01 level. On the other hand, the difference between the ranks of the controls and schizophrenics, when ranked together, were not statistically significant. These probabilities were similar for both the first and second runs.

By repeating the test series about one week later, we gained some indication of the stability of the measure. The differences between 1st and 2nd run means of Table 1 indicate a small reduction of response time or an increase in speed of response in every group. Individual patients in all groups tended to maintain their positions from the first to the second run, as shown by correlations of .71, .88, and .93 for the control, schizophrenic, and brain damaged groups respectively. In the case of the controls and schizophrenics, the reduction in reaction times from the first to the second run proved to be significant, indicating improvement, probably through learning. However, the difference from the first to the second run for the brain damaged group was not significant, most of the variability being due to a markedly improved but still abnormally high score by one patient. In general, the brain damaged patients performed as well on the first run as on the second while maintaining their respective positions within the group.

Inspection of the first run data (to approximate diagnostic test conditions) on individual patients shows a region of overlap between the brain damaged on the one hand, and the controls and schizophrenics on the other, mainly in the range of .85 to .95 second. A series choice reaction time mean on a coöperative individual patient over .95 would be highly suggestive of diffuse cerebral changes, since only one control and no schizophrenic exceeded that figure. Since a minor portion of both damaged and non-damaged patients appeared in the region of overlap between .85 and .95, one could not assign an individual score in this range to the proper distribution with certainty. Scores below .85 appear to have a high degree of probability of belonging to an individual with an intact brain. Larger populations are being studied to define these limits more precisely.

D. Discussion

The length of series choice reaction times shown above merits some attention. Both in this and continuing work with the test, a score below .65 second is seldom seen. The normal scores for the test are then more than double those expected in the choice reaction situation where the subject achieves some level of readiness before the choice stimulus is presented. In the present test, advance preparation is not possible. Aside from the physical inertia of moving the hand a distance of 11¼ inches to the next button, the reaction time is presumably determined by the speed with which one cerebral event can be followed by another. One can speculate that functions involving alerting, discriminating, choosing, and directing response are all telescoped together, yielding a total measure of efficiency of various aspects of cerebral functioning.

If the Series Choice Reaction Time Test does measure inertia in the sense that the score would reflect the summation of inertial effects throughout the process of responding to the results of the previous response, then it would appear that schizophrenic patients are not different in this respect from controls. This result is in agreement with the results obtained with tests presumed to measure sensory, ideational, and motor perseveration separately on the same patient population (1). In this latter study, no significant differences were found between schizophrenic and control groups. The brain damaged group, on the other hand, showed significantly higher degrees of perseveration in all areas measured.

Aside from not showing perseveration in schizophrenic patients, the present results are in marked contrast with previous studies on reaction time in schizophrenic patients. A number of studies report a slower reaction time in schizophrenics (4) as well as difficulty in maintaining a state of readiness (8). In a recent experiment by Knehr (6), two warning intervals in a simple reaction situation were used. Differences in reaction time and readiness were not found. Since the schizophrenic patients could not be distinguished in their performance from controls, the lack of agreement with previous work was tentatively ascribed to the factors of intellectual ability and the effect of long-term hospitalization.

It is believed that the failure to find inertia effects in the present study is due, in part at least, to the fact that the schizophrenic patients, on whom there was no question of diagnosis, had not been progressively deteriorating for many years prior to examination, but represented acute or chronic illnesses without the dilapidation often seen in patients with prolonged psychiatric hospitalization. Six of these schizophrenic patients were paranoid while none were catatonic. The failure to find inertia effects in acute or non-progressively deteriorating patients suggests that increased perseveration may not be an integral characteristic of schizophrenic thinking as such, but may result possibly from diffuse cerebral changes or may be a function of the relatively invariant environment which long term hospitalization often provides. Thus the high degree of similarity between normals and non-deteriorated schizophrenics on tests of perseveration suggests that where markedly increased inertia is found, cerebral damage may also be involved as a superimposed or complicating factor in the illness.

The series choice reaction time clearly differentiates the diffuse brain damaged patients as a group. On purely empirical grounds, it promises to be a useful diagnostic tool, by using certain cut-off scores yet to be established. The test seems to be measuring the often reported inertia of the brain damaged.

E. SUMMARY

Perseveration was studied in three groups of patients consisting of 15 each of convalescent controls, schizophrenics, and diffuse brain damaged, matched for age and intelligence.

In a Series Choice Reaction Time Test presumed to summate the perseverative effects of sensory, central, and motor aspects of function, schizophrenic patients and normals could not be distinguished.

Brain damaged patients evidenced significant slowing of response time compared to normal levels. The test appears to be of diagnostic value in this group above a cut-off score yet to be more precisely determined.

The authors conclude that if this test is a measure of perseveration, schizophrenic thinking impairment is not necessarily characterized as such by differences along the dimension of perseveration, although such effects may be observed after long-term deterioration, or where cerebral organic changes are also present in the illness.

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IS DEATH A MATTER OF INDIFFERENCE?*[1, 2]

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A. PREVIOUS STUDIES

Despite a wealth of conjecture and concern about death in philosophy, religion, literature, biology, the arts, and anthropology, psychologists have remained rather aloof and have neglected death as a subject for study. In the last half century, the psychological literature yields relatively few reports dealing with this concept. Psychological theory has also reflected this neglect. Except for some psychoanalytic and existentialist doctrines (6, 7, 9, 19) one can find no reference to the general importance of the idea of death for human functioning.

The few studies that have appeared may be summarized very briefly. Normal people show very little conscious concern about death (3, 10). Children, old people, and those in psychopathological or socially marginal states express somewhat more conscious interest in the problem (1, 4, 12, 13, 14, 15, 16, 17). This is where the matter rests. It seems rather strange that the evidence from other disciplines would indicate that man is anything but indifferent to the problem of death while the evidence from psychology would relegate concern to special states.

There are many possible explanations for the apparent discrepancy. A very likely one involves the methods psychologists used to gather the data. Most of the above studies utilized questionnaire or interview techniques. Perhaps with regard to death one does not always say what one feels. Or perhaps what one is expected to say differs from what one feels.

The present study is designed to assess concern or "affective involvement" with the concept of death by measuring less conscious aspects of man's responses.

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[1] This research in its later stages was supported in part by a Public Health Service Grant M-1334.

[2] An initial report of this work was presented in Chicago at the *APA* Symposium: The Concept of Death and Its Relation to Behavior, September, 1956.

B. METHOD

A method was sought that would be simple, direct, physiological, psychological, quantitative, and repeatable. The word association task was felt to be most appropriate for obtaining such information and thus the response time, psychogalvanic response, and response word were recorded for a list of stimulus words. The basic procedure was first described by Jung and his students (8).

The composition of the word list was predicated on the following logic. In order to test "affective involvement," the list should contain words related to each other by superordinate concepts that would, by general agreement, be affect-laden for the subjects. In our subject population the concepts chosen were sex and school. As a base line against which to measure, the list should contain "basal" words, that is, words with no apparent general relationship to other words on the list. As a final step there should be included words related to one another under the heading of our critical variable, the concept of death.

The list finally employed consisted of 27 words selected from the Thorndike and Lorge Teacher's Word Book of 30,000 Words (18). It contained 18 "basal" words, three "sex" words, three "school" words, and three "death" words. These sub-groups were balanced with respect to frequency of their usage in the language, length, and number of syllables. The position of a word in the list was determined by a random procedure with the following restriction—no critical word was allowed to follow any other critical word. Some examples from the list follow: *Sex*: romance, maiden, lover. *School*: college, lecture, scholar. *Death*: funeral, death, burial. *Basal*: sunset, insect, criminal, etc. It is to be noted that "basal" words are by no means affect-free. They are samples from the language, each of which can have affective meaning for any subject. Our concern is whether the critical words are more affectively charged than those we have designated as "basals."

1. *Subjects*

The subjects used in this study were 31 male Princeton undergraduates, all of whom were volunteers. Although the subjects were known to one of the experimenters it was felt that they represented a typical sample of the undergraduate population. They were not known to have had psychiatric histories and were all naïve with respect to the purpose of the experiment.

2. *Procedure*

The subject was told that he was helping to determine whether the Sanborn Recorder was an adequate instrument for measuring the psychogalvanic response. After placing his head in a fixed position, the subject was instructed to respond into a telephone receiver with the first word that came to mind after the presentation of the stimulus word. The telephone receiver was used as a voice key to interrupt an electric timing marker which was initiated manually by the experimenter upon presentation of a stimulus word. Measurements were taken of the difference in voltage generated between the palm and the dorsal surface of the hand using the wet electrode and initial rub-down technique described by Bitterman (2). The response time and *PGR* readings were continuously and automatically recorded on heat sensitive paper on the Sanborn Twin-Viso Recorder Model 651-42. The time interval between word presentations varied between 45 seconds and one minute depending upon the rapidity of the subject's return to a resting level. A short, preliminary word group leading right into the regular list was given to settle the subjects in the apparatus.

C. RESULTS

Analyses are available for two separate sets of measurements: the latency of response time and the magnitude of the *PGR*. Both distributions, originally skewed, were normalized by use of a logarithmic transformation. Means were determined for each subject on each of the three sets of words, "basal," "affective" (sex and school), and "death." Differences were assessed by the analysis of variance technique. The results are presented in Table 1.

The *F* ratios indicate that on both sets of measurements there were significant differences in response to the several word groupings and further that there was significant variation among the subjects responding. People react differently to these three sets of words and in a manner that differs from one individual to another.

The more pertinent analysis among word groups was made by deriving distributions of differences and evaluating these differences by use of the *t*-test. The results are found in Table 2.

The logic of our experiment dictated that the first comparison be made between the a priori "affective" words and "basal" words. This was a check on the adequacy of the measuring instrument. For both indices the probability of obtaining such difference distributions by chance alone is less than 1 in 100. The technique of measurement seems appropriate for our purposes. The direction of these differences was consistent in both instances. Longer time and greater *PGR* magnitudes were generally noted for sex and school words as opposed to "basal" words.

TABLE 1
ANALYSIS OF VARIANCE OF *PGR* AND RESPONSE TIME SCORES

Source	*PGR*				Response time			
	Sum of squares	*df*	Mean square	*F*	Sum of squares	*df*	Mean square	*F*
Total	12.30	92			4.25	92		
Between word groups	.2	2	.1	8.55	.07	2	.035	4.86*
Between individuals	11.4	30	.38	32.48	3.75	30	.125	17.36**
Discrepance	.70	60	.0117		.43	60	.0072	

$^{*}p < .05$.
$^{**}P < .01$.

TABLE 2
T VALUES FOR WORD GROUP COMPARISONS ON BOTH RESPONSE MEASURES

Comparison	*PGR*	Response time
"Basal" vs. "affective"	4.60**	2.73**
"Basal" vs. "death"	3.85**	2.66**
"Affective" vs. "death"	.09	.61

$^{**}p < .01$.

The comparisons between responses to "death" words and "basal" words also yielded *t*'s beyond the 1 per cent level of confidence. This population of college students responds in the same way to words relating to death as they do to other words involving affect. Again a longer time was needed to respond and the magnitude of the psychogalvanic response increased for death words when compared with "basal."

The third comparison, between the a priori affective category and the death words, indicates that on both sets of measurements these distributions differ very little and in a manner that could be attributed to chance fluctuation.

D. DISCUSSION

The results of this experiment are clear-cut. A population of normal subjects, in a period of life that is characterized by activity and vigor, responds to words related to death with greater emotional intensity (indicated by *PGR* magnitudes and latency of response time) than to equivalent words drawn from the general language sample. This finding is somewhat at variance with the conscious expressions of relative indifference and lack of concern about death indicated by earlier investigators (3, 10). The differences, however, are not difficult to rationalize. It is likely that we are dealing with two levels of functioning with regard to the death concept. The one involves overt consciously communicated attitudes, the other less conscious processes that can be inferred from response time and *PGR* measurements. In some individuals there is agreement between responses on both levels, in others a wide discrepancy may exist. For example, we might speculate that good accord should be found between verbal report and our measures in certain psychopathological states but at intense values of involvement. This same agreement between measures might obtain for people in states of good mental health but at much more attenuated values. Psychotics may show high concern on both types of measurements, normals very little. In our culture where death is not an ordinary topic of conversation as it may be in some southern European and Asian countries, e.g., Spain, China, Japan, it is perhaps more usual to find a discrepance between the two levels of response. Our cultural values are generally negative to expressions of fear and awe about death and dying; consequently overt attitudes may tend toward indifference. An extreme of the culturally supported view was made evident to us in a preliminary phase of our study. A trial subject whose *PGR* and response time scores were unusually deviant was interviewed informally and at length. During the discussion he presented quite freely his views about various subjects, including his attitudes and feelings about death. The general picture was one of little concern. This was an area that did not seem to occupy his conscious thoughts. In the last moments of the discussion, and then apparently by chance, it was revealed that he was a diabetic and, we may add parenthetically, one whose very existence depended on a dose of insulin administered each morning. While it is an inference that the extreme test responses and the medical condition are linked to one another, it is one that can be checked by further empirical work.

The observations reported in this study point to the fact that perhaps we have overlooked a significant motivating force in human functioning. In effect they lend support to the speculations gleaned from the work of the "existentialists" and from many of the "depth" psychologists, see especially Caprio (5) and Moellenhoff (11). The concern with death would appear to be a force that has a continuing effect and is not confined solely to instances of childhood, old age, and psychopathology. It may be that at these critical times in the life history man is more conscious of his mortal nature and engages in serious efforts to provide some solution to the apparent conflict created between his wish to continue life indefinitely and the knowledge that he must eventually die. In less critical times this struggle may be going on less consciously and may be reflected in a constant search for the meaning of life in such things as religious doctrine, philosophy, and science and may determine to some extent the Weltanschauung of the individual.

What is needed at the present time is more experimentation to provide evidence concerning the way man handles the problem of his own death at various stages of the life history and a theoretical framework within which to order such observations. Our own preference is to investigate carefully that stage of development when death first becomes a conscious problem. It is a well-known finding that children at about five years of age become concerned with the problem of death and how it is related to the self (1, 12). It has also been reported that this problem somehow disappears from the conscious repertoire usually between the ages of 9-12. We might infer that some "solution" has been reached. As a working hypothesis, we shall assume that this "solution" is the critical variable in determining to what extent, and under what kinds of conditions, death will reappear as a conscious problem in later life. The nature of this solution might be estimated by such factors as the stability of the parents, the parent-child relationships, the number of parent substitutes and their characteristics, and the strength of early religious beliefs.

That we as human beings are interested in death hardly needs to be emphasized. The attention that is given to it in our communicative and expressive media attests to the power of its interest value. Perhaps it is time for psychologists to investigate the rôle in human functioning of this universal problem.

E. SUMMARY

As a result of the paradox between mankind's general interest in death and individual man's consciously expressed indifference, this study was undertaken. It was designed to assess the less conscious aspects of emotional involvement with the concept of death in a population of normal subjects. A word association task was employed. The magnitude of the psychogalvanic response and response latency were used as measures of emotional involvement. These measures were found adequate to detect differences between a priori affect-laden concepts and "basal" words.

Male college students respond with greater emotional intensity (longer response times and greater difference in electrical potential) to words logi-

cally related to the concept of death than to words equivalent in frequency of usage, length, etc., but not logically related to one another ("basal words"). It is suggested that, in view of the discrepancy between these results and others using questionnaire and interview techniques, and in view of the significant differences in individual responses found in this study, there may be two levels of functioning in the human organism when dealing with the problem of death. It is argued that psychologists have too long neglected an important source of man's motivation.

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THE SYNERGIC EFFECT OF RESERPINE AND ELECTROCONVULSIVE SHOCK*[1]

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A. PROBLEM

In an experiment recently accomplished at this Laboratory (3) a synergistic relationship between chlorpromazine and electroconvulsive shock (*ECS*) was found which increases the probability of death of the albino rat as compared to an animal subjected to shock alone. The present study was performed to determine whether a similar interaction will be obtained when reserpine and *ECS* are simultaneously administered.

A number of studies (1, 2, 4, 5, 6) have testified to the usefulness of the drugs reserpine and chlorpromazine as therapeutic agents in the clinical situation. In particular, the utility of such therapy in the treatment of mentally and emotionally disturbed patients has been remarked upon. These drugs have occasionally been used simultaneously with *ECS* with the view of obtaining some gratuitous summative effect which will hasten the period of recovery. It is, in part, the object of this study to point up the hazard of this combination therapy.

B. MATERIALS AND METHODS

Eighty female rats, approximately 75 days of age and with an average weight of 140 grams, served as subjects in this experiment. Twenty animals were used to determine *ECS* pattern which is lethal for approximately 1/3 of the normal animals of this age group. A value of 28 separate electrical stimulations (60-cycle *AC*, 1800 V., 175 milliamps), each having a latency of .2-second and separated by a 1.8-second interval, was found to satisfy this requirement. The remaining 60 animals were randomly divided into three groups of 20 each. The three groups correspond to the three treatment conditions of the experiment. These were: (*a*) administration

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of reserpine and *ECS*, (*b*) reserpine and *ECS* in the presence of 5 per cent CO_2 95 per cent O_2, and finally, (*c*) a placebo and *ECS* (control). The drug was injected intramuscularly, each animal receiving .013 mg/gm body weight of the drug three hours prior to administration of *ECS*. Each subject in the control group received an intramuscular placebo injection of distilled water.

ECS was administered through electrodes attached to the subjects' ears. The animals receiving the gases (Group 2, above) were placed in a glass container with a continuous supply of 5 per cent CO_2 95 per cent O_2 one minute prior to and during the shock period. This variable was included to test the hypothesis, that the cause of death was due to respiratory failure.

C. RESULTS

It can be seen from Table 1, which presents the number of deaths occurring during and 24 hours subsequent to *ECS* treatment, that the present results closely correspond with those obtained in a previous experiment (3). The mortality rate under reserpine is four-fold that obtained using the placebo. It can also be observed from Table 1 that the presence of a $CO_2 + O_2$ atmosphere is an affective ameliorative agent to the interaction of the drug with *ECS*.

TABLE 1
SURVIVAL RATES OF 60 ALBINO RATS SUBJECTED TO ELECTROCONVULSIVE SHOCK UNDER THREE TREATMENT CONDITIONS

Group	No.	Living at cessation of *ECS*	Living after 24 hours
Control (Placebo)	20	16	16
Reserpine	20	5	0
Reserpine (5% CO_2, 95% O_2)	20	13	12

The hypothesis that, in the pairing of reserpine and *ECS*, the cause of death is due to respiratory failure is tentatively substantiated in that the stimulation of the respiratory center by CO_2 and the saturation of the blood with O_2 leads to significantly more survivals than in the case of animals under normal atmospheric conditions. The difference between the treatment group having reserpine and that group having reserpine but undergoing *ECS* in an environment of CO_2 O_2 is significant at the .005 level of confidence (Table 2).

A striking behavioral syndrome, following *ECS*, was noticed with reserpine which was not exhibited by the chlorpromazine groups of the earlier study. Each animal receiving reserpine and surviving *ECS* developed a "hunched over" posture with the nose tucked between the fore paws. In the group that did not receive the CO_2 O_2 treatment, when animals survived for a few hours, this posture was spasmodically interrupted by tonic seizures. The reserpine group treated with CO_2 O_2 showed the posture syndrome but did not exhibit the seizures.

TABLE 2
SUMMARY OF X^2 ANALYSIS SHOWING LEVELS OF SIGNIFICANCE FOR DIFFERENCES IN MORTALITY RATES OF THE GROUPS

Treatment groups	Control	Reserpine
Reserpine	.005* .005†	
Reserpine (5% CO_2, 95% O_2)	N.S.* N.S.†	.02* .005†

*Indicates significance of difference at cessation of shock.
†Indicates significance of differences 24 hours after shock.

D. DISCUSSION

Although the reserpine dosage and the level of shock administration used in this study are higher than those which would normally be employed in clinical practice, this experiment does serve to point up the danger of using *ECS* in combination with reserpine administration. Since it has been previously shown that mortality rates using chlorpromazine is dose specific (3), it can be assumed that reserpine acts in a similar manner and that relatively small doses of reserpine will increase the probability of death. It is also suggested from this study that the most probable cause of death from *ECS* and reserpine administration is respiratory failure, and the use of an artificial atmosphere such as 5 per cent CO_2 + 95 per cent O_2 effectively reduces the mortality rate.

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STUDIES IN PHYSIOGNOMIC PERCEPTION: III. EFFECT OF DIRECTIONAL DYNAMICS AND MEANING-INDUCED SETS ON AUTOKINETIC MOTIONS*[1]

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A. THE PROBLEM

In two previous studies we dealt with directional dynamics as it affects the localization of a stationary object in space. As will be recalled, directional dynamics refers to the fact that some perceptual objects express a vectorial quality definable in terms of direction and force. For example, a pictured bird in flight conveys motion in a particular direction. In one experiment significant shifts in the position of the apparent median plane ("straight ahead") were obtained for "directional dynamics" in such figures as triangles, one pointing to the left, the other pointing to the right, or face profiles, one looking to the left, the other to the right: the apparent median plane shifted opposite the direction of the dynamics in the figure (2). In another experiment the apparent horizon was found to shift opposite the direction of the dynamics of such pictures as silhouettes of hands pointing upwards and downwards (1). A third experiment used visually presented verbal symbols connoting upwardness or downwardness, for example "rising" vs. "falling." Analogous to the findings with meaningful pictorial material, the physical position of the apparent horizon shifted opposite to the direction of the dynamics conveyed by the words (1). Finally, it has been found that opposite directional dynamics induced by different meaning-sets in an identical stimulus pattern again result in opposite shifts of the apparent median plane. Just as with pictured objects, when the directional dynamics was to the right the apparent median plane shifted to the left, and vice versa (2).

The present study extends these investigations on directional dynamics beyond measurements of its effects on space localization; it concerns the question whether directional dynamics affects illusory motion, namely, auto-

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kinetic motion, in a systematic manner. Such an influence of directional dynamics is expected from certain inferences drawn from the findings of the above mentioned experiments, couched within the sensory-tonic field theory of perception. In brief, we advance the view that directional dynamics exerts a pull on the organism in the direction of the dynamics which is counteracted by an organismic pull in the opposite direction and that it is this organismic happening which is reflected perceptually in apparent displacement of the object in the direction of the dynamics. This reasoning leads us to hypothesize that the directional quality of a pictured object should affect autokinetic motion so that the stimulus object apparently moves in the direction of the dynamics.

Three experiments were designed to test this hypothesis: the first experiment deals with the effect of directional dynamics in a pictured object on autokinetic motion. The second and third experiments inquire whether differences in autokinetic direction are determined by directional dynamics independent of differences in retinal distribution. For such evaluation an ambiguous stimulus pattern was used in which opposite directional dynamics were induced by different meaning sets. In the second experiment the dynamics induced pertained to the left-right direction; in the third experiment the induced dynamics pertained to the up-down direction.

B. EXPERIMENT 1: EFFECT OF DIRECTIONAL DYNAMICS IN PICTURED OBJECTS ON AUTOKINETIC MOTION

In this experiment figures were used which have a directional dynamics to the left or right. Such figures are expected to induce autokinetic motion in the direction of the dynamics. Thus, a figure having directional dynamics to the left is expected to show autokinetic movement predominantly to the left and a figure with directional dynamics to the right is expected to show autokinetic motion predominantly to the right.

1. *Procedure*

Each of three figures having left-right directional dynamics were presented in a dark room. The figures used were silhouettes of a running horse, a running boy, and an arrow (see Figure 1). Each stimulus figure was presented in two orientations: once facing to the right and once facing to the left. Thus a total of six conditions was used: horse left, horse right, boy left, boy right, arrow left, and arrow right.

The stimulus figures consisted of silhouettes, approximately 12 square inches in area. Each silhouette, cut from a square of black velvet paper, was attached to the milkglass face of a lightbox. This arrangement gave *S* the impression of a luminous silhouette suspended in space. The stimulus figures were dimly illuminated by use of a seven-watt bulb operating at 30 volts a.c. in the lightbox.

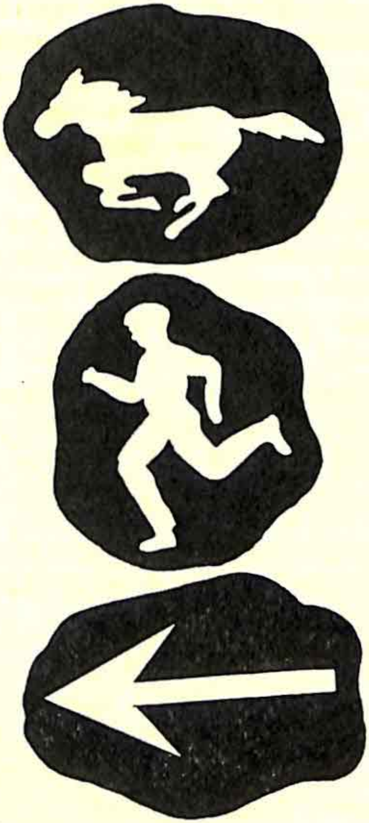

FIGURE 1
EXPERIMENT 1: TEST PATTERNS

Each *S* was led blindfolded into the dark room, seated in a chair with the head fixed into position by a headrest. The stimulus figure was located at *S*'s eye level, straight-ahead at a distance of 12 ft. from *S*. Prior to being led into the dark room, *S* was told that he would see a dimly lit figure straight-in-front-of him which at first would appear stationary, but after a short while would begin to move. Once the figure had begun to move, he was to report continuously on the direction of movement, that is, to state whether the figure moved to the right, to the left, upward or downward; should the figure move obliquely, he was to report this in terms of combined direction, that is, right-up, right-down, left-up, or left-down. The total exposure time for each figure consisted of the time it took *S* for his first movement report and an additional interval of 30 seconds during which the direction of movement was reported and recorded.

The measures used were: (*a*) direction in first report of motion; (*b*) duration of motion in a particular direction during the 30-second interval, measured by number of seconds left, right, etc.

Duration was recorded by four clocks; each of these clocks, respectively, recorded one of the four movements, viz., movement to the left, movement to the right, movement up, and movement down. Combined movement such as up-right was recorded by the use of two clocks.

A total of 12 subjects was tested in a 6 x 6 Latin square design with two subjects in each sequence.

2. *Results*

In this experiment we are concerned with the question whether the directional dynamics of the stimulus figure is a significant factor in determining the direction of autokinetic motion. The measure used for the analysis of the data is the difference in duration of autokinetic motion to the right and the duration of autokinetic motion to the left; arbitrarily, a plus score was assigned to indicate predominance of autokinetic motion to the right; a minus score indicates predominance of autokinetic motion to the left.

The analysis of these difference scores is shown in Table 1. The *F*-test for directional dynamics is significant beyond the .01 level. The mean scores for directional dynamics left vs. directional dynamics right are shown in the lower half of the table separately for each stimulus figure. In keeping with the hypothesis, when the direction of the dynamics in the figure is to the left, the motion is predominantly to the left (—5.4 seconds), and it is predominantly to the right when the direction of the dynamics in the figure is to the right (+13.9 seconds). This relationship holds for each of the three stimulus figures.

It may simply be noted that the stimulus figures showed no differential effects with respect to upward versus downward autokinetic motion.

The effect of directional dynamics was also evaluated by considering in which direction the motion first appeared to *S*. It was found that, with figures having dynamics to the left, six *S*s gave first responses predominantly to the left, one *S* gave responses predominantly to the right, and five *S*s showed predominance neither to the left nor right. In contrast, with directional dynamics in the stimulus figure to the right, none of the *S*s showed predominance to the left in their first report, two showed predominance neither to the left nor right, 10 showed predominance to the right in their first report. Thus the first reports of the *S*s point predominantly to autokinetic motion in the direction of directional dynamics of the stimulus figure. Again, in regard to up-down direction, the first reports of the *S*s are consonant with the results of the up-down analysis based on the first measure; these first reports give no evidence of differential effects of left-right directional dynamics of the figures on upward vs. downward motion.

TABLE 1

EXPERIMENT 1: EFFECT OF DIRECTIONAL DYNAMICS IN PICTURED OBJECTS ON AUTOKINETIC MOTION

		Difference score (R-L)		
Source of variation	*df*	Mean square	*F*	*P*
Individuals (I)	11	227.19	—	—
Sequence	5	316.27	2.07	$>.05$
Is within seq.	6	152.97	<1.00	$>.05$
Ordinality	5	100.57	<1.00	$>.05$
Conditions	5	1,405.06	—	—
Figures (F)	2	40.65	<1.00	$>.05$
Dynamics (D)	1	6,737.67	26.47	$<.01$
F x D	2	103.17	<1.00	$>.05$
Square uniqueness	20	206.61	<1.00	$>.05$
Error	30	254.51	—	—
Total	71	—	—	—

Mean Difference Scores (R-L)*
(secs.)

	Direction of dynamics		
	Left	Right	Over-all mean
Horse	—4.6	+10.1	+2.8
Boy	—5.5	+15.4	+4.9
Arrow	—6.2	+16.3	+5.1
Over-all mean	—5.4	+13.9	

*A plus score indicates predominance of autokinetic motion to the right; a minus score indicates predominance of autokinetic motion to the left.

The results of both measures, one based on first reports, the other on the reports during the 30-second period, are in accord with the hypothesis: directional dynamics of pictured objects influence the direction of autokinetic motion consonant with the direction of the dynamics in the stimulus figure.

C. EXPERIMENT 2: EFFECT OF MEANING-INDUCED SETS (LEFT-RIGHT DYNAMICS) ON AUTOKINETIC MOTION

Though significant differences in autokinetic motion were obtained for directional dynamics inherent in the figures presented in the above experiment, the interpretation of the results may still be considered equivocal. Since the stimuli issuing from the "physiognomic" figures in the two different orientations, left vs. right, differ in retinal distribution from each other, the question can be raised whether the significant differences in autokinetic motion might not be a function of these very differences in retinal distribution rather than the directional dynamics factor in the figures. This equivocality in our interpretation would be ruled out if a single stimulus pattern were used into which opposite dynamics were induced; under such conditions differences in effect could then be unequivocally attributed to the dynamics per se. These considerations led to the methodology employed in the second and third experiment. Here the following hypothesis was tested: autokinetic motion occurs in the direction of the directional dynamics induced into an ambiguous test figure by different meaning sets.

1. *Procedure*

The ambiguous stimulus pattern presented could be seen either as a bird flying in one direction or an airplane flying in the other direction. The procedure was identical with the first experiment, with the exception of the instructions given to the subjects: before the test proper, half of the *S*s were told that they would see a picture of a flying bird, and the other half that they would see a picture of a flying airplane. The stimulus pattern (see Figure 2) was presented in two positions: Test Pattern 1—airplane left or bird right; Test Pattern 2—airplane right or bird left. For each meaning-set the sequence of test patterns was controlled. Twenty-four *S*s were tested in an independent methods group analysis of variance design.

2. *Results*

As in the previous experiment the measure employed was based on the difference between duration of autokinetic motion to the right and to the left. A plus score indicates predominance of autokinetic motion to the right, a minus score indicates predominance of autokinetic motion to the left. Analysis of variance of the difference scores is presented in Table 2. The expectation is that for each of the two stimulus patterns defined by its position, there should be a difference in the direction of autokinetic motion between the group to whom the stimulus pattern was presented as a bird and the group who was to see the stimulus pattern as a plane. That is, with Test Pattern 1—airplane left or bird right—the airplane group was expected to show a predominance of autokinetic motion to the left (minus scores) and the bird group a predominance of autokinetic motion to the right (plus scores). In contrast, with Test Pattern 2—airplane right or bird left, the airplane group was expected to see autokinetic motion predominantly to the right and the bird group predominantly to the left. Thus the critical comparison should show a statistical interaction between "instructional set" and "test pattern" as specified above.

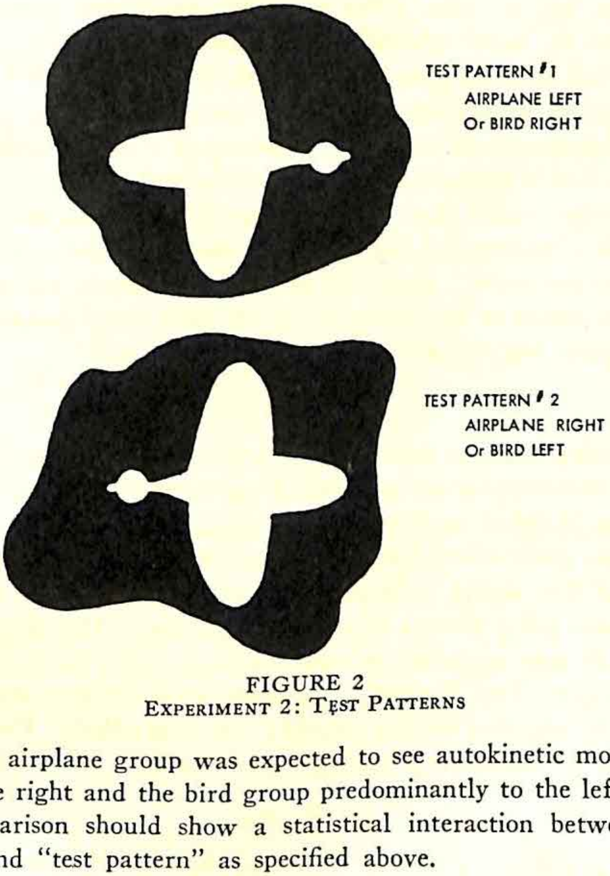

FIGURE 2
EXPERIMENT 2: TEST PATTERNS

The analysis of variance presented in Table 2 shows that the interaction between instruction and test pattern is statistically significant. For Test Pattern 1 (airplane left or bird right), the airplane group shows a predominance of autokinetic motion to the left (—7.9 seconds), whereas the bird group shows predominance of motion to the right (+8.2 seconds). This relationship is reversed with Test Pattern 2 (plane right or bird left):

here, for the airplane group the autokinetic motion is predominantly to the right (+8.2 seconds), whereas for the bird group it is predominantly to the left (—11.7 seconds). Thus, when right vs. left directional dynamics is introduced by different meaning-sets the direction of autokinetic motion differs in consonance with the directional dynamics induced in the figure by the instructions.

TABLE 2
EXPERIMENT 2: EFFECT OF LEFT-RIGHT DIRECTIONAL DYNAMICS INDUCED BY A SET ON AUTOKINETIC MOTION

Source of variation	(Difference scores) *df*	Mean square	*F*	*P*
Between individuals (I)	23	104.69	—	—
Group-instructional set (G)	1	44.00	<1.00	>.05
Is within G	22	107.45	<1.00	>.05
Within Is	24	284.83	—	—
Test pattern (P)	1	40.00	<1.00	>.05
I x P	23	295.48	—	—
G x P	1	3,889.00	29.43	<.01
Pooled I x P	22	132.14	—	—
Total	47	—	—	—

Mean Difference Scores (R-L)*
(secs.)

Group	1. Airplane left or bird right	2. Airplane right or bird left
Plane set	—7.9	+ 8.2
Bird set	+8.2	—11.7

*A plus score indicates predominance of autokinetic motion to the right; a minus score indicates predominance of autokinetic motion to the left.

D. EXPERIMENT 3: EFFECT OF MEANING-INDUCED SETS (UP-DOWN DIRECTIONAL DYNAMICS) ON AUTOKINETIC MOTION[2]

This experiment, like the previous one, was concerned with the influence of directional dynamics induced by meaning-set upon the direction of autokinetic motion in a stimulus pattern. In this experiment—otherwise identical with the previous one—the effect of directional dynamics was tested in regard to the up-down dimension.

1. *Procedure*

The stimulus pattern here, as in Experiment 2, was again an ambiguous one, viz., a figure which could be seen, according to instruction, as a balloon with dynamics upward or as a parachute with dynamics downward. Prior to actual testing, half of the *S*s were told that they would see a balloon, the remaining half that they would see a parachute.

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[2] This experiment was designed and carried out by Clara Mayo.

The luminous silhouette was set at eye level, approximately 12 feet from *S*.

The method of recording time of movement was the same as in the previous two experiments; here, the duration measure was based on the difference between duration of autokinetic motion upward and downward. A plus score indicates predominance of motion upward, and a minus score, predominance of motion downward.

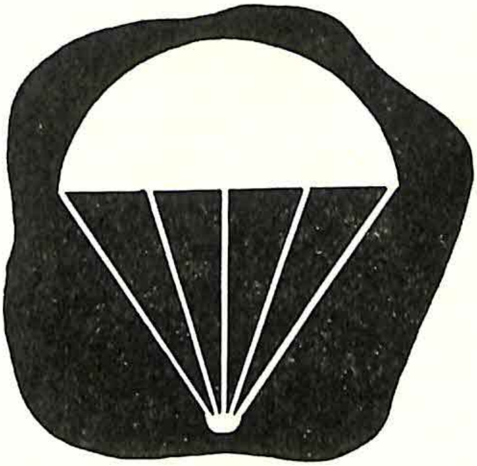

FIGURE 3
EXPERIMENT 3: TEST PATTERNS

Thirty-two *S*s, 16 men and 16 women, were tested.

2. *Results*

With the Balloon Group autokinetc motion was predominantly in the upward direction (mean = +18.4 secs.); with the Parachute Group the direction of motion was predominantly downward (mean = —8.9 secs.). The mean difference, 27.3 secs., is highly significant (t = 24.91; 30 *df*; $p < .01$).

A parallel analysis was carried out with respect to left-right direction. For the two instructional sets no significant differences in duration of left vs. right autokinetic motion were obtained. Thus the findings of Experiment 3 are analogous to those of Experiment 2: they indicate that the direction of autokinetic motion is determined by the directional dynamics induced in an ambiguous picture by meaning set.

E. DISCUSSION

The three experiments reported in this paper provide further evidence on the validity of the proposition that objects possess expressive qualities. In these experiments, the objective behavioral measurement of expressive qualities, here in terms of directional dynamics, has been further verified by demonstrating its efficacy on autokinetic motion. Moreover, two of the experiments viz., 2 and 3, in conjunction with an earlier experiment on space localization (2), show that the directional differences obtained cannot be attributed to differences in retinal distribution but rather to the dynamics per se.

Experiments 2 and 3 also provide a further demonstration of the way in which meaning can be experimentally introduced within the framework of sensory-tonic theory. These experiments utilize instructions as to the meaning of an ambiguous stimulus pattern as the independent variable and show that autokinetic motion occurs in the direction of the inherent dynamics of objects emerging from the meanings assigned to them.

We should like to discuss briefly these effects in the light of the previous findings dealing with localization in space. There we have demonstrated that pictured objects are displaced in consonance with the directional dynamics inherent in them: with upward or downward directional dynamics the picture is displaced respectively upwards or downwards; with directional dynamics to left or right the displacement occurs respectively to the left or to the right. The present three experiments differ from the earlier ones insofar as the displacement exerts itself here not within static space but in regard to motion. As one will recall, our interpretation of the earlier experiments was that pictorial forms with directional dynamics exert a pull on the organism in the direction of the dynamics which is counteracted by an organismic pull in the opposite direction. As to autokinetic motion we assume that it, like other perceptual phenomena, also is affected by changes in organismic state.

Thus, without further elaboration, if we consider motion under the general concept of shifts in localization, the sensory-tonic interpretation concerning shifts in static space may be generalized to include the observed changes in autokinetic motion.

F. SUMMARY

Three experiments were carried out to demonstrate that visual directional dynamics exist as a behaviorally measurable event. Directional dynamics refer to dynamic properties of objects, such as the directional quality

in a picture of a bird in flight. Left-right and up-down directional dynamics have a significant effect on autokinetic motion: autokinetic motion occurs consonant with the direction of the dynamics in the stimulus figure.

In addition to objectively demonstrating visual dynamics by means of behavioral measurement, the study shows how meaning, induced by instruction, can be treated experimentally and interpreted within an organismic theory of perception.

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A REEVALUATION OF A FACTORIAL STUDY OF THE COMPONENTS OF MUSIC*

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This article is a further interpretation of the author's factorial study of the components of music (3). The purpose in doing this is to discover whether the original factor pattern can be clarified by the use of factorial rotation.

In the original factor study musical compositions were chosen by the experimenter to represent melody, rhythm, harmony, and orchestral color. These compositions, all recorded, were also chosen as representative of a diversified cross-section of period and style of writing. The recordings are listed below.

1—A portion of the 2nd movement of Schubert's 2nd Symphony in B Flat Major; 2—The Sacrificial Dance from Stravinsky's The Rite of Spring; 3—A portion of Griffes' The White Peacock; 4—A portion of the 4th movement of Mendelssohn's Symphony No. 4 in A Major; 5—The 2nd movement of Vivaldi's Concerto in A Major for Strings and Cembalo; 6—A portion of Debussy's Nuages; 7—The Steel Foundry by A. Mossolov; 8—The prelude in C Major from Vol. I of J. S. Bach's Well Tempered Clavier; 9—A portion of the 2nd movement of Kabalevsky's Symphony No. 2 in C Minor; 10—A portion of the 2nd movement of Tschaikowsky's Symphony No. 4 in F Minor.[2]

The purpose of the original study was to show that (*a*) musical factors do exist, and that (*b*) these factors correspond to those forming the basis of musical writing and appreciation. The technique used was to quantitatively compare the musical factors of those compositions which the author had chosen for their significant factor loadings in melody, rhythm, harmony, or orchestral color with a factorial analysis of the preference judgments of a group of listeners. The author's choice was based on his training and musi-

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[1] The author thanks Drs. A. L. Comrey and G. E. Mount of U. C. L. A., department of psychology, for their assistance in the preparation of this work.

[2] The numbers assigned the recordings above are used to refer to each of the compositions throughout the discussion.

cal experience. The listeners' preference was made by their rating the compositions on a preference scale of pleasantness-unpleasantness. These preference ratings were then submitted to a factor analysis and the relationship between the preference ratings and the author's basis of selection and classification of the compositions determined. That is, the analyzed subject ratings were related to the predicted factor loadings for each composition. To ensure reliability of results the recordings were presented to the same group at two hearings, four weeks apart.

The resulting factor matrices, one for each listening session, appear in an earlier study (3) and indicate a close correspondence between the predicted factor loadings of the author and the factor preference judgments of the listeners.[3] The results were interpreted as providing evidence for the previous hypotheses.

Specifically, three independent, orthogonal factors were uncovered by the analysis of the unrotated factors of the original factor matrices. These were designated Factor *A*, the melodic factor, Factor *B*, the rhythmic factor, and Factor *C*, the orchestral color factor. Other factors, *D* and *E*, were found but not interpreted.

In the present factor analysis study the unrotated factor matrices of the original study were rotated by Thurstone's method of rotation of axes by orthogonal and oblique methods (5).[4] The rotated factor matrices appear in Tables 1 and 2.

Since oblique rotations were used the $\lambda' \lambda$ matrices for F_I' and F_{II}', showing their direction cosines, appear in Table 3.

These matrices indicate that the factors involved are no longer strictly orthogonal as they were in the unrotated matrices. However, deviations from the orthogonal condition are slight and, with respect to Factors A′, B′, and D′, these deviations are negligible. Thus, following rotation, Factors A′, B′, and D′ can be considered independent.

Upon comparison of the unrotated and rotated matrices it can be seen that rotation yields mathematically simpler, more clear-cut results. One observes in the rotated studies a better approximation of simple structure and positive manifold. Thus the conclusion drawn from this study is that the rotation was of value since it did simplify the unrotated matrices.

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[3] The factor matrices were designated F_I for the analysis made from the first administration of the recordings, F_{II} for the second.

[4] These factor matrices were designatd F_I' and F_{II}' indicating rotation of the previously unrotated matrices F_I and F_{II}.

The rotation also allows a more definitive interpretation of the previously unrotated matrices musically. Factor A′ is clearly the melodic factor since significant factor loadings are present only in those recordings previously selected as being strongly loaded melodically. Factor B′, by analogy, can be interpreted as the rhythmic factor, Factor C′, the orchestral color factor, and Factor D′, a second, previously unpredicted melodic factor. Factor E′ is not interpreted.

TABLE 1
ROTATED FACTOR MATRIX F_I'

	A_I'	B_I'	C_I'	D_I'	E_I'
1	.05	—.06	.00	.45	.00
2	.00	.64	.02	.00	.07
3	.54	—.03	—.02	.01	.09
4	.10	—.01	—.01	.60	.13
5	—.08	.28	.06	.39	—.15
6	.43	.24	.00	—.04	—.17
7	—.21	.65	.00	.00	.21
8	.01	.02	.78	—.02	.14
9	.50	.05	.01	.05	.00
10	.30	.04	.13	.33	.00

TABLE 2
ROTATED FACTOR MATRIX F_{II}'

	A_{II}'	B_{II}'	C_{II}'	D_{II}'	E_{II}'
1	.08	.00	.18	.56	.01
2	—.02	.48	.00	—.05	.02
3	.51	.00	—.01	—.06	.04
4	.05	.02	.00	.65	.24
5	.06	.02	.20	.04	.43
6	.40	.02	.08	—.05	.01
7	.00	.26	.00	.13	.07
8	—.17	.05	.50	—.11	.00
9	.43	.01	.09	.06	.12
10	.26	—.01	.00	—.03	.02

TABLE 3

DIRECTION COSINES OF THE ROTATED FACTORS IN MATRIX F_I'

	A	B	C	D	E
A	1.00				
B	0.00	1.00			
C	0.06	—0.10	1.00		
D	0.00	0.00	0.04	1.00	
E	—0.07	—0.30	0.36	0.33	1.00

DIRECTION COSINES OF THE ROTATED FACTORS IN MATRIX F_{II}'

	A	B	C	D	E
A	1.00				
B	0.04	1.00			
C	0.09	0.26	1.00		
D	0.00	0.09	0.01	1.00	
E	—0.07	—0.11	0.38	0.50	1.00

There appears to be a close correspondence between the unrotated and rotated factor matrices with the rotated matrices appearing simpler to interpret. Factor *A* corresponds to Factor A′, Factor *B* to Factor B′, and Factor *C* to Factor C′. Factor D′, which developed as a result of the rotation process, is primarily loaded in recordings previously selected as melodic. It is thus interpreted as a portion of the melodic factor. However, it did not appear in the unrotated factor analyses and bears no relation to Factor *D*. Its mathematical appearance, its variance, is explained by rotation from the previous Factor *A*. Its musical characteristics can be noted if one observes in Factor *A* that the loadings of both Factors A′ and D′ appear combined. This indicates that Factor D′ bears some musical relation to Factor *A* representing some melodic relationship not indicated by Factor A′. The isolation of Factor D′ is one more indication of the usefulness and success of the rotation method.

A complete discussion of the meaning of all the factors can be found in previous studies (2, 3, 4). However, interpretation of factors A′, B′, and D′ appears to be most important since factors representing melody and rhythm account for the major portion of the total variance of the factor study (45 per cent of the variance of the unrotated factor matrices). Similarly, these factors are independent and represent the two most important independently operating response systems present in the preference study (and by assumption in other behavioral responses associated with music). Other factors may also be in operation, determining in part the subject preference judgments. However, such other determiners of response are of relatively less importance.

The above interpretations placed upon the rotated factors correspond closely to those drawn from the unrotated studies. In addition, analysis of the rotated factor matrices allows us to make one fundamental statement concerning the melodic and rhythmic factors which was not clearly evident in the previous interpretations: that Factors A′, B′, and D′ are independent mathematically and psychologically. This means that the subject's judgment of melody (as interpreted by a scaled judgment of pleasantness or unpleasantness) is independent of his judgment of rhythm (also interpreted by a scaled affective judgment).

Demonstration of the independence of Factors A′, B′, and D′ by means of a verbal response, makes it reasonable to suppose that this independence can be shown in other response mechanisms. Any measurable physiological change taking place in association with the playing of melodic or rhythmic compositions could be used to indicate this independence. For example, a melodic stimulus could produce a recorded change in subject response which manifests itself by some change in one given direction, while a rhythmic stimulus may be expected to produce a change in subject response which moves in the opposite direction. It is also logically possible that the two stimuli, even though independent, may vary in the same direction in another response situation.

These last statements are hypotheses. They are indicated by the general factor analysis technique which states that the present response determiners are linearly related and additive in their effect on preference. This linear combination of determiners can be defined by the "factor analysis equation" or what Cattell calls the specification equation; i.e., $R_1 = x_1A + y_1B$, $R_2 = x_2A + y_2B, \ldots R_n = x_nA + y_nB$ (1). This result makes it conceivable that the melodic and rhythmic determiners of the preference response can be shown by other response mechanisms in any manner in which their linearity and additive qualities are kept intact. However, experimental evidence limits this simple interpretation, since the additive relationship may take a more complex form; e.g., the negative addition of factors. Thus, the coefficients of A may be consistently larger than those of B due to some undefined cause. This is in fact indicated in the present study by the larger percentage of the total variance contributed by the unrotated melodic factor over the unrotated rhythmic factor. This may indicate, especially with respect to preferences or physiological responses made at the subjects' first hearing of a musical composition, that the melodic component is more effective in controlling the judgment or physiological response than the rhythmic factor. In this sense, the melodic determiners may be expected to influence any preference or physiological response more than the rhythmic determiners.

It is the above hypotheses which have formed the basis of further experimentation conducted by the author in this field of study (4).

SUMMARY

This article clarifies a previous factor study by use of factorial rotation. In the original study musical factors were found to exist and form the basis of musical composition and appreciation. These factors were melody, rhythm, and orchestral color. Upon rotation these same factors were identified and defined more clearly. In addition, a factor representing another form of the melodic factor was uncovered. Of prime importance is the fact that the melodic and rhythmic factors are shown to be independent mathematically and psychologically and that they represent the two most important inde-

pendently operating response systems in the preference study. It is assumed that this independence and importance will hold in any other measurement of behavioral responses associated with music.

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PRELIMINARY STANDARDIZATION OF THE POLYDIAGNOSTIC INDEX*[1]

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In general, association techniques are well established diagnostic methods in both clinical psychology and psychiatry. Free association is a major tool of psychoanalysis. Both word association and Rorschach techniques have long histories of research and application. Many of these techniques are finding increasing acceptance in other than the clinical areas, especially in industry and education. And yet, although these methods supply a rich body of clues for interpretation, they are unfortunately difficult to deal with at an empirical level. As a result of this difficulty, the advantages of statistical investigation cannot always be applied for improvement of these procedures.

The polydiagnostic method (1) is a forced-choice procedure designed to elicit patterns of associations in a quantitative form open to empirical investigation. The procedure calls for presenting the subject with a standardized set of 15 descriptive terms. The subject is then asked a question in the following form: "How do you feel about xxx? From these words choose the three which describe xxx the most."

The subject makes his judgment and chooses three terms. The instructions are then repeated, using the 12 remaining terms, and the subject again selects three. Again the subject is instructed to select three terms from the remaining nine. And finally he selects three from the six, leaving three terms.

In this way the subject structures his thinking about the referent under consideration and forms a unique pattern of the 15 terms in the set confronting him. The pattern contains three associations in each of five subgroups: the first three chosen (called *A* associations in the following discussion), the second three chosen (*B* associations), the third three chosen (*C* associations), the fourth three chosen (*D* associations), and the three remaining (*E* associations).

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[1] The second in a series of papers considering basic aspects of a new experimental procedure for the multi-variate assessment of thought and personality.

We assume that if the subject were asked to describe the referent in question *the most*, the *A* associations are those most closely associated with the referent, the *E* associations are those least closely associated. If, however, the instruction were to describe the referent *the least*, then the *A* items would be those least closely associated with the referent, and the *E* items would evidence closeness of association.

In the following discussion those items in the most closely associated sub-group are referred to as ++ associations, in the least closely associated sub-group as — — associations, as outlined in Table 1.

TABLE 1
ASSOCIATION PATTERNS

Assumed meaning	Sub-group Referent described the most	 the least	Qualitative symbol	Quantitative score*
Strongest associations	A	E	++	+4
Strong associations	B	D	+	+3
Associations	C	C	0	+2
Weak associations	D	B	—	+1
Weakest associations	E	A	— —	0

*These quantitative scores are used at present in all empirical research calling for the statistical handling of group data. At present the assumption of cardinality is made.

The Polydiagnostic Index is a standardized form of the method. The core of the index is 20 sets of 15 descriptive terms each. The instructions used with these sets of terms have been designed for personality assessment. In this standardized Index, the assessment is restricted to the areas of (1) self-concept, (2) motives, (3) values, and (4) concept of the social environment. Other areas of assessment might be tapped by altering the instructions for any set of terms. However, the standardization data presented here deal with only the standard questions used for these four areas.

Since the subject deals with 20 sets in turn, there is a configuration of 300 associations, varying in strength from ++ to — —. One hundred and fifty of these associations are with the self, 30 are with needs and desires, 45 are with values, and 75 are with the social environment.

Preliminary standardization of the Index is based upon the responses of 1,300 subjects, approximately equally divided as to sex and ranging in age from 15 to 64. Not all subjects were administered the entire Index, therefore not all sets were responded to by an equal number of subjects.

The distribution of respondents as a function of age was skewed by comparison to the age distribution in the national population. Therefore statistical corrections were made to compensate for this imbalance in age. Since the number of cases varied from set to set, it was necessary to make individual age corrections for each item, for each sex, separately. The procedure used to correct for age was as follows.

For each characteristic (a specific term in a specific set) the respondents were first dichotomized as a function of sex. Then each sex group was divided into four age sub-groups: I (Ages 15-19), II (20-29), III (30-44), IV (45-64). The age break was made in this manner on the assumption that personality becomes increasingly stable as a function of increasing age. As a result small age ranges in youth might be equated to larger age spans in later life.

TABLE 2

DISTRIBUTION OF THE POPULATION AS A FUNCTION OF AGE AND SEX*

Age	Total population	Proportion of population
	Males	
15-19	4,685,825	10.7
20-29	10,352,489	23.7
30-44	14,650,080	33.5
45-64	14,016,586	32.1
Total (15-64) *Males*	43,704,980	100.0
	Females	
15-19	4,644,695	10.5
20-29	10,751,502	24.2
30-44	14,995,014	33.8
45-64	14,036,545	31.6
Total (15-64) *Females*	44,427,756	100.0

*1950 U. S. Census, urban white.

The actual population of urban whites in the 1950 U. S. Census was determined for these eight groups (see Table 2).

The distribution of responses to each item for each of these eight subgroups was then determined. The cell frequencies in each of the eight separate distributions were then multiplied by a correction factor (K), in order to produce frequencies which would approximate those which would have been obtained had our sample represented precisely the natural age distribution.

$$K = \frac{\text{proportion of the number of this sex in this age range (U. S.)}}{\text{proportion of the number of this sex in this age range (sample)}}$$

After introducing the correction, the four separate age distributions were recombined to form one corrected distribution for each sex. The final distributions were thus corrected to match the national population figures for the various age groups within the over-all age range of 15 to 64.

The distributions thus corrected, for men and women separately, for each of the 300 adjectives are given in Tables 3 through 9.

These data may serve as preliminary standardization with certain important reservations. First, we cannot be sure of the socio-economic level of the subjects used in the standardization group. Second, most were drawn from the urban northeast, mainly from the Metropolitan Boston area. Third, since the distributions were skewed with respect to age, a statistical correction was introduced and the effects of this cannot be evaluated. Finally, the sample's relation to its parent population is not known exactly. Therefore distribution shifts cannot be readily evaluated.

As a result, a word of caution must be introduced. Although these distributions have been corrected for age and are dichotomized as a function of sex, they can be treated only as gross representations of the distributions which would result from national age and sex quota sampling. As cases are added to the standardization pool to increase the total size of the group, and as the geographical and socio-economic distribution widens, increased precision may then be possible.

When using these data in a normative analysis of individual patterns, deviations from the norm should be noted most cautiously. Rather than make an overly precise judgment from distributions of only limited precision, it has been our practice to comment only on association patterns which are above the 75th, or below the 25th percentiles for the subject's sex group. This gives a measure of the subject's deviation or nonconformity to the common pattern of responses, without giving the impression of extreme abnormality.

To facilitate such analysis, brackets enclose at least the middle 50 per cent of the standardization distributions. Only those positions which contain less than the top 25 per cent or less than the bottom 25 per cent are outside the bracketed middle area. For other cutting lines, these brackets may be ignored and the distributions used directly.

Patterns for individual subjects can be assessed with approximately the same rationale as applies to patterns obtained with other association techniques. One of the simplest forms of analysis requires only that all of the ++ items be gathered together, all of the —— items gathered together, and so on. This forms a picture of those qualities which constitute the self-associations, those that are antithetical to the self, etc. Similar analyses

TABLE 3
POSITIVE ASSOCIATIONS WITH THE SELF*

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
1: 1	Accurate	11.2	[23.0	18.7	23.1]	24.2	3.8	11.6	[25.1	24.3	35.1]
1: 2	Calm	12.1	9.0	[25.9	26.5	26.7]	3.2	10.9	[14.3	31.4	40.4]
1: 3	Competent	20.4	[33.7	21.0]	16.7	8.0	10.9	[35.9	21.1	21.0]	10.7
1: 4	Decent	[30.6	27.9	21.4]	10.6	9.6	[33.2	29.1	27.1]	6.6	1.0
1: 5	Firm	6.2	11.2	[14.7	36.9	30.9]	1.3	4.3	14.1	[27.6	52.8]
1: 6	Generous	16.9	[24.0	28.9	14.8]	15.5	[29.2	32.8	23.1]	10.9	4.0
1: 7	Honest	[41.3	34.6]	15.0	6.4	2.8	[55.0	20.7]	21.8	1.9	0.6
1: 8	Loving	24.4	[17.2	23.6	22.3]	12.8	[38.4	22.4	22.1]	10.7	6.4
1: 9	Modest	6.7	[19.7	24.1	28.2]	21.6	6.6	14.9	[31.0	38.1]	9.3
1:10	Patient	7.5	10.1	[15.5	26.5	41.1]	15.1	9.1	[13.4	31.6	30.9]
1:11	Prompt	[29.5	20.6	17.4	17.1]	15.6	14.2	[23.1	9.9	28.1]	24.8
1:12	Reliable	[45.7	20.3	21.2]	10.7	2.2	[29.0	36.5	21.0]	10.4	3.2
1:13	Serious	22.6	[16.4	24.4	21.2]	15.7	24.9	[14.8	26.0	15.8]	18.4
1:14	Spiritual	10.3	9.8	[9.5	12.8	57.7]	7.5	16.2	[8.0	16.0	52.4]
1:15	Thankful	14.6	[23.0	20.0	26.9]	15.8	[28.3	13.9	21.6	26.6]	9.9
2: 1	Affectionate	24.3	[20.1	19.0	16.1]	20.7	[37.7	14.3	34.7]	8.8	4.5
2: 2	Careful	12.6	11.8	[23.3	23.4	29.1]	3.5	12.6	[20.3	31.6	32.1]
2: 3	Contented	10.0	8.1	[18.2	22.3	41.5]	16.2	7.8	[17.7	18.6	39.9]
2: 4	Exact	10.9	[19.4	18.4	23.1	28.4]	0.9	10.9	12.4	[21.6	54.1]
2: 5	Frank	[28.1	21.6	17.4	28.3]	4.6	19.7	[12.0	18.4	23.4	26.2]
2: 6	Gentle	15.7	[15.8	30.2	20.6]	17.7	8.2	[20.8	38.5	27.9]	4.6
2: 7	Intelligent	20.8	[41.0	26.9]	6.4	4.9	20.4	[37.6	21.8]	13.9	6.3
2: 8	Loyal	[32.5	28.8	25.2]	10.4	3.3	[27.3	34.5	21.5]	15.7	1.1
2: 9	Moral	19.8	[26.4	15.5	28.6]	9.6	[29.1	35.2	18.3]	12.3	4.8
2:10	Peaceful	16.2	[22.7	27.5	24.6]	9.1	8.1	[23.6	14.2	36.3]	17.9
2:11	Proper	4.9	12.5	[23.6	28.7	30.5]	6.7	15.7	[13.3	23.6	40.6]
2:12	Religious	16.0	[9.6	6.7	25.6	42.3]	6.8	14.9	[13.2	27.7	37.4]

*The instruction: "How do you feel about yourself? From the list of words below, choose the three which describe you *the least*." Since the instruction *the least* was used, the ++ column reports the percentage of times the characteristic was left for one of the last three items (the *E* sub-group). The —— column reports the percentage in the *A* sub-group.

N = 364 (Set 1), 362 (Set 2), 363 (Set 3), 357 (Set 4), 357 (Set 5), 353 (Set 6).

TABLE 3 (*continued*)

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
2:13	Sincere	[56.0	24.5]	12.3	6.3	0.9	[63.9	22.9]	12.1	0.8	0.4
2:14	Strong	7.7	11.6	[16.9	27.0	36.7]	3.9	7.6	[28.5	30.2	29.8]
2:15	Understanding	20.0	[27.1	22.2	10.4]	20.5	[45.0	31.4]	15.5	7.9	0.2
3: 1	Alert	15.2	[24.6	29.6	17.1]	13.7	22.0	[17.7	24.3	20.3]	16.0
3: 2	Cheerful	6.3	[22.7	34.7	28.4]	8.2	22.2	[27.9	23.1	21.9]	5.2
3: 3	Courteous	[30.4	32.7	16.7]	10.1	10.3	[31.8	23.3	30.5]	11.4	3.0
3: 4	Faithful	[37.0	16.1	25.3]	15.8	5.9	[31.3	29.4	23.2]	13.7	2.4
3: 5	Friendly	[30.4	25.6	18.3	20.4]	5.4	[41.5	18.4	19.6]	12.9	7.9
3: 6	Graceful	4.3	7.1	9.6	[21.2	57.9]	1.3	10.0	[15.4	31.7	41.9]
3: 7	Joyful	4.0	15.6	[13.6	39.5	28.0]	4.2	17.3	[18.6	34.2	25.7]
3: 8	Manly	17.0	[23.3	19.3	27.2]	13.2	4.6	4.8	3.0	12.4	[75.5]
3: 9	Neat	24.6	[19.6	14.2	16.3	25.2]	13.4	[29.4	28.9	12.8]	15.8
3:10	Powerful	4.4	6.2	[17.6	18.2	53.8]	2.5	3.2	4.2	[22.3	68.0]
3:11	Quick	17.9	[31.0	14.9	26.5]	9.6	16.9	[19.2	18.7	28.1]	17.2
3:12	Respectable	[38.0	22.5	24.6]	9.2	6.0	[36.7	32.1	13.2]	17.4	0.9
3:13	Smart	21.8	[16.1	23.7	19.8]	18.9	17.0	[14.6	21.1	36.5]	11.1
3:14	Sympathetic	[25.2	17.5	19.4	12.5	25.6]	[40.1	28.5	13.6]	13.9	4.1
3:15	Willing	24.6	[19.5	18.4	18.6]	19.2	14.7	[24.3	38.8]	15.8	6.5
4: 1	Brave	7.5	12.0	[22.0	24.7	34.2]	4.7	4.1	15.4	[35.1	40.8]
4: 2	Clean	[30.9	23.5	27.2]	17.6	1.0	[47.2	22.4	17.0]	3.8	10.0
4: 3	Curious	20.9	[23.2	30.8	15.7]	9.8	17.2	[19.7	20.7	25.3]	17.4
4: 4	Fearless	4.2	1.4	7.3	[22.7	64.5]	2.9	2.6	8.6	[24.5	61.9]
4: 5	Gallant	4.6	5.6	[22.8	29.7	37.5]	0.2	5.1	14.5	[29.0	51.4]
4: 6	Grateful	12.9	[33.2	26.8	20.8]	6.5	19.9	[42.7	15.9]	16.7	5.0
4: 7	Kind	[30.4	37.8	18.7]	12.2	1.1	[46.8	32.2]	13.9	4.3	3.1
4: 8	Mature	[28.5	24.3	20.2	16.2]	11.1	22.7	[28.8	29.0]	14.2	5.9
4: 9	Original	[28.9	16.8	12.2	18.7]	23.4	7.2	10.1	[8.9	31.5	42.5]
4:10	Practical	[31.8	18.1	18.4	18.4]	13.4	[35.2	13.2	28.8]	13.2	9.8
4:11	Reasonable	[31.2	22.7	19.7	21.0]	5.5	[25.3	32.6	23.6]	14.0	4.9
4:12	Responsible	[44.2	27.1	15.7]	8.5	4.8	[40.5	31.2	17.6]	9.3	1.6
4:13	Social	11.8	[14.6	15.7	24.9	33.0]	8.0	[20.7	26.8	30.4]	14.4
4:14	Tender	7.7	11.7	[16.3	24.5	39.9]	20.9	[21.2	25.8	19.1]	13.3
4:15	Wise	4.6	[28.4	27.6	24.8]	14.8	2.6	15.6	[30.0	33.1]	18.8

TABLE 3 (*continued*)

Set: Item	Characteristic	Percentages of responses									
		Male					Female				
		++	+	0	—	— —	++	+	0	—	— —
5: 1	Active	17.0	[25.1	18.2	23.9]	15.8	[25.1	12.3	19.9	27.4]	15.4
5: 2	Ambitious	20.0	[21.3	28.8	11.0]	18.7	18.3	[18.3	17.0	19.6	26.7]
5: 3	Brilliant	1.2	7.3	6.2	9.6	[75.7]	6.9	3.6	4.4	[12.6	72.7]
5: 4	Capable	[30.2	29.6	20.6]	12.3	7.3	[31.9	33.0	20.1]	10.9	4.1
5: 5	Earnest	11.8	[30.3	38.6]	16.3	2.9	18.8	[31.1	25.4]	21.9	2.9
5: 6	Happy	18.7	[18.2	30.2	16.9]	15.9	20.6	[30.2	24.4	19.6]	5.5
5: 7	Merry	2.7	8.0	9.0	[31.8	48.5]	7.4	16.3	[13.5	22.3	40.5]
5: 8	Normal	[44.9	20.4	15.5]	10.7	8.5	[36.9	24.8	17.8]	18.4	2.4
5: 9	Pure	1.6	4.3	7.4	[35.3	51.6]	9.8	12.1	[18.9	24.6	34.5]
5:10	Sane	[43.8	25.3	22.2]	5.2	3.4	[36.7	31.0	15.6]	13.3	3.6
5:11	Sensible	[47.1	32.8]	14.1	4.0	2.1	[34.9	27.9	22.4]	7.9	6.9
5:12	Skillful	12.9	[14.1	12.1	33.7	27.3]	12.4	8.8	[15.1	29.0	34.9]
5:13	Stable	20.1	[21.8	23.0	27.7]	7.6	11.4	[22.5	26.5	18.8]	21.0
5:14	Steady	14.9	[29.1	28.1	24.0]	4.0	12.3	11.8	[31.2	26.0]	18.9
5:15	Upright	13.3	[12.3	25.4	37.2]	11.7	19.0	[13.3	29.3	27.9]	10.5
6: 1	Athletic	18.8	[8.1	23.1	12.0	38.2]	16.4	[18.8	14.9	7.8	42.4]
6: 2	Commercial	6.7	10.4	[19.1	39.4	25.1]	4.2	[28.9	15.4	28.6]	23.0
6: 3	Democratic	[39.7	26.4	23.2]	7.5	3.3	[53.2	35.0]	5.7	1.3	4.8
6: 4	Domestic	22.5	[26.1	21.8	19.0]	10.6	[52.5	22.2	8.8]	9.0	7.8
6: 5	Economic	13.1	[24.9	34.9	19.1]	8.1	22.0	[32.6	17.0	18.4]	10.3
6: 6	Executive	[31.1	19.6	18.6	22.6]	7.9	16.1	[30.7	18.0	21.5]	13.9
6: 7	Individualistic	[37.5	30.0	8.1]	13.6	11.0	[29.3	29.1	18.2]	6.5	16.9
6: 8	Industrial	7.3	[27.2	27.5	27.4]	11.2	4.9	18.1	[27.3	37.1]	13.3
6: 9	International	10.7	[22.9	19.8	18.5	28.2]	17.9	[15.3	32.9	23.4]	10.8
6:10	Mechanical	19.0	[24.1	18.8	11.0	26.9]	10.3	8.9	[12.0	44.0]	24.9
6:11	Professional	[41.9	23.6	19.8]	11.2	3.5	[36.9	19.0	27.9]	7.3	9.3
6:12	Radical	5.0	5.4	11.6	[29.5	48.3]	4.8	6.0	[21.6	27.6	40.3]
6:13	Revolutionary	0.9	19.0	[11.1	24.0	45.2]	5.8	12.0	[23.4	26.6	32.7]
6:14	Scientific	24.7	[19.1	19.9	23.6]	13.1	13.5	[14.9	30.5	19.0]	22.4
6:15	Technical	21.0	[14.4	23.2	21.9]	19.7	10.5	14.1	[26.7	23.0	25.7]

TABLE 4
Negative Associations With the Self*

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
7: 1	Angry	11.3	[29.4	27.3	21.7]	10.3	24.0	[15.8	29.0	23.8]	7.5
7: 2	Bitter	15.2	[36.9	19.0	20.5]	8.3	12.8	[16.2	34.7	19.3]	17.0
7: 3	Childish	11.0	[17.7	38.9	19.4]	12.9	24.7	[29.2	18.2	19.0]	9.0
7: 4	Evil	3.0	4.3	14.3	[17.1	61.1]	0.8	0.7	9.5	[20.5	68.5]
7: 5	Feeble	6.2	12.7	[9.9	32.5	38.5]	2.7	10.8	9.0	[32.6	45.0]
7: 6	Gloomy	21.9	[30.5	18.9	14.3]	14.4	9.1	[32.7	25.9	26.1]	6.4
7: 7	Hasty	[56.8	15.4	13.3]	8.0	6.3	[66.5	17.8]	9.5	6.0	0.3
7: 8	Jealous	[29.0	18.2	31.2]	11.1	10.5	[35.3	17.9	21.0	11.8]	14.0
7: 9	Loud	23.1	[18.6	16.1	27.2]	15.1	14.0	[23.6	21.8	25.8]	14.6
7:10	Reckless	21.2	[17.7	25.2	27.2]	8.7	20.2	[29.6	21.7	21.9]	6.7
7:11	Savage	2.8	13.4	[20.6	19.4	43.7]	2.9	3.6	14.9	[29.2	49.5]
7:12	Silly	12.8	[22.4	19.8	33.4]	11.6	21.4	[24.9	23.3	19.7]	10.6
7:13	Stupid	4.0	9.1	10.2	[33.8	42.9]	1.7	18.4	[27.5	18.2	34.2]
7:14	Vain	[33.5	29.7	23.4]	6.9	6.7	21.0	[33.4	19.4	15.4]	10.8
7:15	Weary	[47.9	24.4	11.7]	7.1	9.0	[43.6	25.6	14.4]	10.3	6.2
8: 1	Anxious	[63.3	22.7]	7.0	3.0	4.2	[67.5	16.1]	13.4	1.0	2.2
8: 2	Careless	[34.9	35.0	20.5]	5.3	4.4	[51.0	27.5]	16.1	5.3	0.2
8: 3	Clumsy	13.7	[33.3	29.9]	15.8	7.4	22.7	[42.3	23.9]	6.9	4.3
8: 4	False	5.1	12.3	[17.5	31.3	34.0]	3.7	2.6	[20.2	39.2	34.4]
8: 5	Foolish	17.7	[29.8	33.5]	16.7	2.4	11.8	[39.0	34.7]	10.4	4.2
8: 6	Greedy	6.7	16.6	[21.7	40.8]	14.1	1.6	[28.7	12.5	47.8]	9.4
8: 7	Helpless	0.9	7.5	[31.7	39.1]	20.8	9.9	[21.5	35.9	20.1]	12.6
8: 8	Lazy	[26.8	33.5	15.1]	15.5	9.1	[28.0	22.5	34.6]	10.5	4.7
8: 9	Lying	0.2	12.2	11.6	[37.0	38.9]	2.7	1.6	8.7	[29.1	58.0]
8:10	Rough	13.5	[19.1	27.7	22.3]	17.5	6.3	12.2	[18.0	44.3]	19.3
8:11	Selfish	[36.1	29.6	12.6]	14.7	7.1	16.2	[33.6	29.7]	16.8	3.8
8:12	Slow	[38.5	19.3	22.8]	13.1	6.2	21.1	[26.4	23.4	20.7]	8.4

*The instruction: "How do you feel about yourself? From the list of words below, choose the three which describe you *the most*." Since the instruction *the most* was used, the ++ column reports the percentage of times the characteristic was chosen in the first three items (the *A* sub-group). The —— column reports the percentage in the *E* sub-group.

$N = 352$ (Set 7), 350 (Set 8), 340 (Set 9), 351 (Set 10).

TABLE 4 (*continued*)

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
8:13	Timid	[31.9	17.1	25.4	15.7]	9.8	[49.1	18.6	19.4]	10.3	2.7
8:14	Violent	7.8	9.7	[15.0	11.3	56.0]	8.0	7.0	8.0	[25.5	51.6]
8:15	Wicked	3.0	2.7	8.3	[18.1	67.9]	0.8	0.6	8.3	12.4	[78.1]
9: 1	Ashamed	8.2	[28.4	37.7	18.7]	7.7	8.4	[36.3	29.7	17.3]	8.5
9: 2	Cheap	1.1	18.8	[19.0	20.9	40.2]	0.2	1.5	16.2	[36.4	45.8]
9: 3	Cruel	5.5	7.1	[27.0	27.2	33.3]	0.9	4.4	[27.7	36.3	30.8]
9: 4	Fearful	17.1	[49.5	16.7]	12.6	4.3	[41.8	42.3]	9.8	2.6	3.7
9: 5	Fierce	0.4	11.8	[18.5	28.0	41.5]	1.3	6.2	[26.2	25.9	40.5]
9: 6	Guilty	8.2	[20.7	28.2	23.1]	19.8	8.1	[23.6	24.6	25.4]	18.3
9: 7	Hostile	11.6	[15.2	43.4	21.0]	8.9	7.2	[32.7	28.2	25.0]	7.0
9: 8	Lonesome	[36.4	27.9	19.0]	14.7	2.0	[34.3	33.8	18.1]	8.6	5.2
9: 9	Nervous	[58.2	21.4]	6.3	11.9	2.2	[70.8	16.0]	4.1	6.4	2.7
9:10	Rude	13.7	[20.5	26.2	26.0]	13.9	7.4	14.3	[40.8	28.1]	9.4
9:11	Shallow	6.1	[24.0	10.7	29.3	30.0]	10.7	12.1	[30.8	28.9]	17.5
9:12	Stubborn	[54.8	11.5	12.1]	15.1	6.5	[39.8	37.4]	8.7	9.3	4.7
9:13	Uncertain	[60.8	16.0]	5.0	10.5	7.5	[64.7	27.1]	4.9	0.6	2.8
9:14	Vulgar	9.1	10.1	[8.4	22.1	50.3]	0.9	3.1	10.0	[21.9	64.2]
9:15	Wild	9.0	[17.5	21.5	18.0	34.1]	3.9	8.9	[21.1	29.9	36.2]
10: 1	Backward	[28.9	19.9	19.0	21.8]	10.3	21.9	[14.3	21.4	31.4]	11.0
10: 2	Crazy	9.6	9.9	[13.1	14.2	53.0]	6.6	7.0	[16.7	18.4	51.4]
10: 3	Dangerous	6.3	5.4	4.1	[37.6	46.5]	1.8	3.4	11.1	[31.9	52.0]
10: 4	Desperate	12.3	[16.5	15.5	34.3]	21.3	14.6	[19.6	23.9	18.3]	23.6
10: 5	Dull	[39.7	13.9	23.9]	14.6	7.8	[43.7	16.0	22.8]	13.9	3.6
10: 6	Ignorant	8.3	[20.2	26.4	24.6]	20.2	11.5	[25.3	14.0	33.0]	16.4
10: 7	Mad	12.9	9.4	[15.5	23.4	38.7]	14.8	7.9	[19.4	25.0	33.1]
10: 8	Miserable	10.6	[24.2	37.6	17.4]	10.9	11.0	[33.2	24.0	22.9]	8.8
10: 9	Odd	[41.7	21.1	20.6]	9.6	6.9	[32.5	21.6	21.0]	14.1	10.9
10:10	Sad	[34.0	43.0]	12.0	6.5	4.4	[29.2	34.2	19.7]	9.4	7.4
10:11	Sorry	[33.3	35.8	17.0]	8.6	5.1	[45.6	31.6]	15.9	6.2	0.9
10:12	Unhappy	[25.9	31.7	23.6]	4.4	14.5	[30.8	30.2	19.0]	9.5	10.5
10:13	Unwholesome	3.8	11.8	[17.4	27.7	39.2]	1.2	8.5	[17.8	27.5	44.9]
10:14	Wretched	5.1	16.8	[26.7	38.2]	13.2	7.5	[21.0	23.1	27.9]	20.3
10:15	Wrong	[25.4	21.8	29.8]	17.0	5.8	[28.1	26.3	28.1]	12.4	5.1

TABLE 5
DESIRABLE POSITIVE ASSOCIATIONS*

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
11: 1	Beautiful	2.0	0.5	3.5	5.7	[88.4]	9.5	[15.6	30.5	17.5	27.2]
11: 2	Famous	6.2	14.0	[14.6	32.1	33.0]	5.1	5.0	[18.4	32.9	38.5]
11: 3	Free	24.4	[27.8	25.4]	6.7	15.8	14.8	[39.6	21.6]	12.3	11.9
11: 4	Great	4.4	16.3	[20.8	37.0]	21.8	7.1	6.9	[17.0	33.5	36.2]
11: 5	Handsome	4.8	6.7	[14.3	34.4	40.2]	0.2	2.8	5.2	[18.4	73.5]
11: 6	Healthy	[79.3]	6.6	6.3	5.1	3.1	[74.3	14.4]	10.3	0.9	0.3
11: 7	Important	4.4	15.7	[29.8	46.6]	3.9	0.8	15.7	[30.4	36.7]	17.3
11: 8	Loved	[45.2	34.2]	9.9	6.7	4.1	[66.9	20.1]	11.1	0.3	2.0
11: 9	Lucky	0.7	12.7	[15.0	33.2	38.6]	2.2	13.8	[30.2	34.2]	20.4
11:10	Popular	5.3	[29.5	32.8	29.8]	2.9	12.7	[24.0	41.5]	15.3	6.9
11:11	Prominent	7.8	[20.1	33.8	16.4]	22.4	5.1	6.3	[20.5	40.0	28.4]
11:12	Rich	7.1	[21.2	42.8	16.0]	13.1	12.6	11.1	[22.7	33.8]	19.9
11:13	Safe	3.3	[37.0	29.2	25.2]	5.4	10.1	[44.5	16.2	15.8]	13.6
11:14	Secure	[44.2	29.4	16.2]	6.3	4.0	[55.0	27.3]	14.4	1.2	2.4
11:15	Successful	[61.3	28.7]	6.8	3.0	0.4	24.1	[54.0]	13.6	6.1	2.4

*The instruction: "If you had just three wishes, what would you *most* like to be? From the list of words below, choose the three which you would *most* like to be." Since the instruction *the most* was used, the ++ column reports the percentage of times the characteristic was chosen in the first three items (the *A* sub-group). The —— column reports the percentage in the *E* sub-group.

$N = 379$ (Set 11).

TABLE 6
Tolerable Negative Associations*

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
12: 1	Afraid	22.9	[28.1	21.7	15.2]	12.3	[32.6	23.3	17.8	16.6]	9.9
12: 2	Bad	22.5	[15.4	10.4	28.0]	24.1	11.0	11.7	[21.5	36.5]	19.6
12: 3	Blind	13.9	3.7	[21.8	19.5	41.3]	9.6	11.7	[9.8	20.8	48.1]
12: 4	Disgusting	3.1	13.0	[11.7	32.8	39.5]	3.1	11.8	[14.6	32.3	38.4]
12: 5	Disliked	12.3	[31.6	24.5	14.4]	17.3	14.8	[17.4	14.5	23.1	30.3]
12: 6	Hungry	[27.6	24.4	22.8	14.7]	10.7	[36.3	18.9	21.2]	17.3	6.6
12: 7	Inferior	5.4	[31.1	26.8	24.7]	12.3	8.7	[22.6	27.7	30.0]	11.1
12: 8	Lame	[39.5	25.7	14.9]	10.3	10.0	[33.9	28.9	20.2]	8.8	8.3
12: 9	Lonely	12.7	[30.3	26.3	16.9]	13.8	10.8	[27.1	26.0	23.9]	12.3
12:10	Lost	[43.5	25.9	17.2]	7.8	5.8	[42.4	29.2	13.8]	9.2	5.5
12:11	Peculiar	24.6	[18.9	32.1]	21.5	3.0	20.8	[20.3	35.0]	16.7	7.1
12:12	Poor	[38.0	17.3	22.1]	21.5	1.3	[45.1	21.8	22.5]	10.5	0.3
12:13	Sick	2.4	7.9	13.2	[27.7	48.8]	6.3	14.7	[21.2	19.1	39.1]
12:14	Ugly	[29.1	19.5	21.4	18.2]	11.9	16.9	[26.9	25.3	20.2]	10.8
12:15	Useless	3.1	8.1	13.3	[27.4	48.0]	5.8	11.8	[10.2	19.2	53.1]

*The instruction: "If you had just three wishes, what would you *least* like to be? From the list of words below, choose the three which describe what you would *least* like to be." Since the instruction *least* was used, the ++ column reports the percentage of times the characteristic was left for one of the last three items (the *E* sub-group). The —— column reports the percentage in the *A* sub-group.

N = 374 (Set 12).

TABLE 7
VALUED ASSOCIATIONS*

		Percentages of responses									
				Male					Female		
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
13: 1	Bold	17.4	[21.4	28.1	23.8]	9.5	4.0	[30.0	30.7	21.8]	13.9
13: 2	Conservative	[31.2	34.9	18.6]	11.0	4.3	22.0	[29.6	27.4]	16.1	5.1
13: 3	Definite	[38.9	48.6]	6.4	5.6	0.6	[45.3	35.5]	14.1	5.3	0.0
13: 4	Different	4.8	13.7	[29.8	28.4]	23.4	5.1	[20.1	33.1	28.7]	13.2
13: 5	Formal	2.0	6.1	[39.0	38.0]	15.0	0.0	1.6	[27.6	51.0]	19.9
13: 6	Humble	[50.3	29.6]	8.1	5.5	6.7	[67.5	14.6]	6.2	4.2	7.9
13: 7	Liberal	[50.1	26.7]	9.0	7.3	7.4	[70.7	19.5]	7.3	2.5	0.2
13: 8	Mysterious	0.0	9.3	4.5	[28.2	58.2]	0.4	0.8	16.7	[38.4	44.1]
13: 9	Particular	12.0	[35.7	31.1]	20.7	0.9	16.5	[47.8	29.6]	3.0	3.3
13:10	Proud	[27.3	13.1	31.3	18.9]	9.6	20.1	[37.4	21.2]	18.6	2.8
13:11	Restless	4.6	8.4	[18.4	30.8	38.0]	2.9	4.8	9.1	[37.5	45.8]
13:12	Sharp	[28.2	14.9	16.2	16.7]	24.3	13.9	[23.5	21.8	16.7]	24.4
13:13	Simple	[26.4	16.8	25.1	10.0]	21.7	[29.7	27.8	14.1	11.4]	17.2
13:14	Solemn	1.4	23.3	[23.7	36.6]	15.2	2.9	7.5	[35.0	35.3]	19.6
13:15	Suspicious	6.0	1.6	[11.4	15.4	65.6]	0.4	0.4	9.6	6.9	[82.9]
14: 1	Clever	[39.6	26.4	24.6]	6.8	2.7	[40.2	34.2	12.8]	9.9	3.2
14: 2	Critical	8.6	[16.7	25.9	17.0	32.1]	4.1	20.3	[18.9	29.0	28.1]
14: 3	Delicate	1.0	6.8	[31.3	19.5	41.7]	0.5	19.0	[22.6	33.8]	24.4
14: 4	Direct	[39.9	35.1	11.2]	10.0	4.0	[41.1	28.3	21.9]	8.4	0.4
14: 5	Funny	5.8	[21.0	22.0	26.9]	24.3	5.7	5.7	[34.1	30.9]	23.8
14: 6	Independent	[45.8	23.7	10.3]	18.5	2.0	[55.0	31.5]	9.3	3.3	1.0
14: 7	Mental	3.2	14.0	[12.8	14.9	55.3]	10.5	[18.0	10.5	9.5	51.8]
14: 8	Natural	[68.4	19.1]	5.4	1.5	5.6	[77.6]	8.2	14.2	0.0	0.2
14: 9	Passionate	8.7	[16.8	17.0	30.3	27.4]	0.6	10.6	[26.3	27.5	35.2]
14:10	Quiet	11.6	[37.1	17.6	23.3]	10.5	1.9	[27.3	27.3	35.7]	7.9
14:11	Sensitive	13.0	[21.1	17.7	27.4]	20.9	[29.9	22.3	19.6	13.5]	14.9
14:12	Shrewd	18.7	[11.1	25.5	32.2]	12.6	16.5	[17.6	15.4	28.2]	22.6

*The instruction: "To be happy and satisfied, what should a person be like? From the list of words below, choose the three which most describe what a person *should be*." Since the instruction *the most* was used the ++ column reports the percentage of times the characteristic was chosen in the first three items (the *A* sub-group). The —— column reports the percentage in the *E* sub-group.

$N = 351$ (Set 13), 351 (Set 14), 371 (Set 15).

TABLE 7 (*continued*)

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
14:13	Smooth	14.6	[27.0	31.1	12.4]	15.2	2.7	[26.4	28.4	23.1]	19.5
14:14	Stern	5.0	6.0	[25.3	41.5]	22.4	5.1	1.6	15.1	[25.5	52.9]
14:15	Sweet	16.3	[18.9	22.5	18.4]	24.0	9.8	[29.8	23.8	22.4]	14.7
15: 1	Cold	2.8	7.1	9.9	[30.7	49.6]	0.4	9.2	3.6	[28.1	58.3]
15: 2	Cunning	15.8	[20.1	20.1	14.1	29.9]	8.2	[17.1	20.6	18.4	36.0]
15: 3	Dependent	17.3	[19.3	12.8	19.4	31.2]	17.0	[18.7	17.7	31.3]	15.7
15: 4	Distant	0.5	16.5	[35.8	29.8]	17.5	2.2	10.3	[21.4	48.0]	18.3
15: 5	Hard	6.4	18.0	[29.5	20.4	25.8]	2.6	10.6	[12.5	17.1	57.5]
15: 6	Innocent	24.6	[34.5	13.3	18.4]	9.4	13.2	[42.1	23.3]	10.3	11.4
15: 7	Modern	[49.0	24.8	10.6]	15.3	0.5	[73.8	19.2]	3.8	1.1	2.5
15: 8	Old-fashioned	14.0	[17.4	27.1	24.2]	17.4	1.5	17.9	[47.6	21.4]	11.8
15: 9	Progressive	[67.6	13.8]	7.3	2.4	9.0	[88.4]	7.1	3.2	0.9	0.4
15:10	Remote	4.1	11.6	[38.6	20.3	25.6]	2.5	15.0	[34.2	31.5]	17.0
15:11	Severe	4.3	14.5	[23.7	30.6	27.1]	0.0	11.2	[16.7	33.5	38.7]
15:12	Shy	0.2	[27.3	16.8	30.4	25.4]	4.2	[31.2	34.8	15.3]	14.9
15:13	Soft	18.1	[18.7	15.1	27.7]	20.7	19.5	[25.4	21.0	20.9]	13.4
15:14	Strict	20.7	[34.2	29.1]	11.3	4.8	6.4	[45.1	27.3]	17.1	4.3
15:15	Youthful	[54.8	23.1]	11.2	4.8	6.2	[61.4	20.0]	13.2	5.5	0.2

TABLE 8

Positive Associations With the Social Environment*

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	— —	++	+	0	—	— —
16: 1	Brave	12.9	[16.8	28.3	31.7]	10.2	16.5	[17.6	24.7	24.4]	16.7
16: 2	Cheerful	[29.2	23.2	19.9	24.0]	4.2	[40.7	29.8	19.8]	8.4	1.2
16: 3	Decent	[42.5	11.4	21.5]	16.1	8.7	[54.7	18.0	8.4]	9.4	9.6
16: 4	Firm	19.5	[30.5	15.9	20.0]	14.2	17.7	[16.6	22.3	22.4]	20.7
16: 5	Gallant	5.2	10.6	[27.6	22.7	33.9]	6.2	9.1	[12.9	38.6	33.5]
16: 6	Graceful	16.3	[13.6	20.8	25.5]	23.7	6.1	[28.4	25.3	26.2]	14.2
16: 7	Intelligent	[29.1	22.1	23.2	10.8]	14.9	23.9	[42.2	17.0]	5.0	11.9
16: 8	Modest	8.6	[30.6	26.3	8.4	26.3]	9.1	[23.9	28.1	22.6]	16.8
16: 9	Original	4.8	17.5	[18.8	21.9	37.0]	12.3	6.5	[19.3	30.0	31.8]
16:10	Powerful	14.2	[22.9	16.8	22.6]	23.6	15.4	7.5	[19.1	20.9	37.1]
16:11	Proper	14.0	[35.3	25.9	18.8]	6.3	15.7	[24.9	25.1	21.5]	12.6
16:12	Religious	17.8	[23.1	14.2	24.9]	20.2	17.4	[19.1	24.3	16.7]	22.6
16:13	Sincere	[37.7	14.4	9.5	26.7]	11.8	23.6	[24.7	17.8	18.4]	15.5
16:14	Spiritual	15.5	[13.3	12.9	17.3	40.9]	12.8	11.4	[15.4	26.7	33.9]
16:15	Understanding	[30.2	16.0	18.1	10.5	25.4]	[27.5	21.4	20.2	9.2]	22.0
17: 1	Calm	10.9	10.3	[27.4	23.1	28.3]	8.4	6.8	[27.7	34.8]	22.2
17: 2	Clean	[35.6	34.3	12.8]	12.9	4.3	[31.0	27.3	26.7]	7.2	7.9
17: 3	Exact	12.2	11.7	[13.1	27.8	35.1]	7.7	9.5	[14.5	22.4	46.2]
17: 4	Frank	15.0	[13.0	23.1	18.4	30.4]	8.8	8.4	[25.3	24.8	32.9]
17: 5	Generous	[29.0	25.2	12.7	21.4]	11.7	[28.2	25.8	18.0	12.2]	15.7
17: 6	Grateful	22.8	[17.1	28.4	14.4]	17.3	11.6	[25.8	14.9	23.2]	24.8
17: 7	Kind	[40.6	21.8	27.8]	6.0	3.9	[46.3	21.8	17.1]	10.0	4.9
17: 8	Moral	16.7	[22.1	26.3	15.3]	19.4	13.5	[29.8	28.0	16.7]	12.4
17: 9	Patient	14.9	[14.6	13.5	33.5]	23.5	15.9	[15.6	9.9	14.6	44.1]
17:10	Practical	20.4	[21.3	22.6	19.2]	16.5	[26.7	21.7	26.4	14.9]	11.0
17:11	Quick	22.0	[14.1	17.5	28.0]	18.2	16.7	[25.8	14.5	27.9]	15.6
17:12	Responsible	11.3	[34.2	19.4	12.4]	22.8	14.5	[25.0	18.3	24.1]	18.9

*The instruction: "How do you feel about people in general? From the list of words below, choose the three which describe people in general *the least*." Since the instruction *the least* was used, the ++ column reports the percentage of times the characteristic was left for one of the last three items (the *E* sub-group). The — — column reports the percentage in the *A* sub-group.

$N = 367$ (Set 16), 354 (Set 17), 365 (Set 18).

TABLE 8 (*continued*)

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	— —	++	+	0	—	— —
17:13	Smart	12.7	[19.1	22.4	26.2]	19.7	18.4	[23.3	25.4	21.0]	12.3
17:14	Strong	13.6	[16.9	17.4	25.8	26.2]	17.4	[18.0	20.0	24.4]	20.0
17:15	Willing	22.0	[23.9	15.6	15.8]	22.7	[28.4	10.1	20.8	20.0]	12.1
18: 1	Careful	11.0	13.8	[18.0	17.4	40.0]	8.5	14.3	[13.4	40.7]	23.0
18: 2	Curious	[42.0	12.7	14.6	17.3]	13.3	[34.9	15.7	18.7	10.5]	20.2
18: 3	Faithful	11.3	9.9	[22.4	37.0]	19.4	17.6	[13.1	21.8	22.4]	25.0
18: 4	Friendly	[44.1	19.0	19.8]	9.4	7.8	[55.4	25.4]	6.5	5.6	7.2
18: 5	Gentle	10.8	[22.6	35.8	20.5]	10.2	12.5	[22.3	21.1	31.4]	12.5
18: 6	Honest	[31.2	21.9	21.0	8.1]	18.0	[28.1	37.3	15.8]	11.5	7.4
18: 7	Loyal	10.2	[22.2	27.1	22.0]	18.3	8.4	[21.9	33.1	22.9]	13.9
18: 8	Neat	17.4	[35.0	26.2]	16.7	4.8	23.9	[22.7	17.3	15.1]	21.0
18: 9	Peaceful	22.7	[29.0	15.2	17.4]	15.9	10.9	[28.7	17.4	19.5]	23.6
18:10	Prompt	16.8	[11.9	16.8	23.6	31.2]	10.0	10.8	[11.7	27.2	40.3]
18:11	Reasonable	14.2	[23.8	8.5	22.3	31.5]	18.8	[13.9	19.9	30.0]	17.5
18.12	Serious	8.8	[25.3	22.7	33.4]	10.1	11.9	[29.2	27.7	18.3]	13.0
18:13	Social	[41.5	25.7	10.6]	15.5	7.0	[39.8	21.2	21.5]	8.3	9.4
18:14	Tender	9.4	[20.5	14.5	24.3	31.4]	12.0	[13.8	27.0	19.2	28.2]
18:15	Wise	8.9	7.0	[27.4	15.4	41.7]	7.3	10.4	[25.4	19.1	38.0]

TABLE 9

NEGATIVE ASSOCIATIONS WITH THE SOCIAL ENVIRONMENT*

		Percentages of responses									
		Male					Female				
Set: Item	Characteristic	++	+	0	—	——	++	+	0	—	——
19: 1	Angry	6.0	16.9	[21.4	38.6]	17.4	8.2	7.3	[20.4	59.4]	5.0
19: 2	Ashamed	9.4	12.1	[27.2	28.8]	22.5	0.7	13.8	[31.6	45.6]	8.5
19: 3	Cheap	13.1	[15.5	25.5	29.4]	16.6	3.0	4.3	[26.9	46.2]	19.8
19: 4	Evil	6.7	4.8	2.6	[26.5	59.7]	0.4	2.9	2.8	3.5	[88.4]
19: 5	Fearful	[35.5	31.2	16.3]	15.6	1.6	[42.9	29.8	14.4]	7.6	5.4
19: 6	Foolish	[26.9	32.3	29.2]	10.7	1.1	23.3	[38.0	33.1]	5.5	0.4
19: 7	Hasty	[46.5	24.9	21.9]	4.7	2.1	[53.5	30.3]	10.0	6.1	0.4
19: 8	Jealous	[29.8	34.7	22.2]	8.5	5.0	[25.2	39.4	26.3]	8.6	0.6
19: 9	Loud	19.2	[31.3	31.6]	12.9	5.2	15.7	[27.2	29.2	24.9]	3.2
19:10	Nervous	[31.5	32.7	24.9]	9.2	1.9	[50.2	21.3	18.5]	9.3	0.8
19:11	Rough	5.3	8.2	[32.9	45.7]	8.1	10.8	14.1	[25.8	39.5]	9.9
19:12	Savage	1.1	2.6	9.5	[21.4	65.5]	1.1	5.5	6.8	[17.8	69.2]
19:13	Silly	22.3	[30.9	19.1	13.6]	14.3	18.2	[31.1	34.1]	16.2	0.8
19:14	Vain	[46.4	22.4	12.7]	8.0	10.6	[45.0	33.1]	16.0	3.2	3.2
19:15	Wicked	0.5	1.3	4.2	[26.1	67.8]	2.3	2.9	2.7	7.7	[84.7]
20: 1	Anxious	[72.2	15.9]	4.0	7.3	0.6	[73.8	10.7]	11.5	1.1	3.4
20: 2	Bitter	12.1	[30.8	29.0	16.4]	12.0	3.1	[32.3	39.4	19.5]	5.9
20: 3	Cruel	4.6	12.7	[8.3	21.2	54.0]	2.4	5.3	[19.8	26.0	46.8]
20: 4	False	15.6	[29.7	20.9	21.7]	12.4	17.4	[18.6	25.2	24.5]	14.6
20: 5	Fierce	3.3	3.9	6.0	[18.2	68.7]	0.2	4.1	6.2	[24.8	64.9]
20: 6	Guilty	3.1	18.8	[14.3	47.1]	17.2	5.5	13.7	[17.7	32.4	31.0]
20: 7	Helpless	[31.7	18.6	20.6	18.3]	11.1	[25.2	43.4	12.1]	11.5	8.0
20: 8	Lazy	[33.1	22.7	29.6]	7.8	7.3	[39.9	23.0	21.8]	11.2	4.4
20: 9	Lying	6.1	6.9	[29.3	28.3	29.8]	2.7	8.4	12.6	[42.4	33.9]
20:10	Reckless	18.6	[30.1	18.4	20.5]	12.6	[26.2	28.0	19.0	14.9]	12.0
20:11	Rude	15.8	[33.3	27.7]	19.7	3.8	11.7	[15.3	44.1	26.3]	2.7
20:12	Shallow	[39.9	21.7	17.4]	18.2	3.1	[34.6	26.5	16.4]	14.9	8.0
20:13	Slow	21.1	[30.6	31.0]	8.5	9.1	21.2	[32.5	26.6]	15.0	4.8
20:14	Weary	22.1	[17.2	30.0	16.9]	14.0	[29.6	34.5	16.3]	15.1	4.6
20:15	Wild	1.4	8.0	13.8	[32.2	45.1]	6.7	3.9	12.4	[20.8	56.4]

*The instruction: "How do you feel about people in general? From the list of words below, choose the three which describe people in general *the most*." Since the instruction *the most* was used, the ++ column reports the percentage of times the characteristic was chosen in the first three items (the *A* sub-group). The —— column reports the percentage in the *E* sub-group.

$N = 367$ (Set 19), 361 (Set 20).

can be made for value patterns, need patterns, and associations with the social environment. Areas of conflict between self and society, self and valued self, values and desires, etc., may then be hypothesized.

The empirical nature of the method makes it possible for changes in the subject to appear as finite shifts in the pattern of responses. Similarities and differences within the same subject under changing conditions might thus be noted. Similarities and differences from subject to subject can be compared using a common frame of reference.

However, before full confidence can be placed in an individual's response pattern, or changes in his pattern as a function of changing conditions, reliability must be considered. In this respect, reliability may be defined as the extent to which the specific pattern for a given individual remains constant over a period of time when no known forces are operating to alter the personality structure.

A preliminary study of the stability of individual patterns has been completed, and the results are reported in Table 10.

TABLE 10

TEST-RETEST STABILITY OF INDIVIDUAL ASSOCIATION PATTERNS

	Percentage of associations† Extent of test-retest change					Coefficient of stability‡
Subject*	0	1	2	3	4	
Most stable	59	32	8	1	0	.90
Average	42	39	14	4	1	.79
Least stable	36	38	14	7	5	.65

*Data are reported for the one subject with the highest stability, the average of all 25 subjects, and the one subject with the lowest stability.

†Percentage of the 300 associations for a subject that changed position from test to retest, the time varying from 9 to 21 days.

0 = no change in position from test to retest.
1 = a change of one sub-group position, A to B, C to B, E to D, etc.
2 = a change of two sub-group positions, A to C, D to B, E to C, etc.
3 and 4 = similarly changes of three or four positions respectively.

‡Coefficient.

$$r_s = \sqrt{\frac{S_0^2 - S_\dagger^2}{S_\dagger^2}}$$

Where S_0^2 = actual variance around the line of perfect stability
$S_\dagger^2$ = theoretical variance around the line of perfect stability to be expected on the basis of chance.

$r_s = 1$, perfect stability; $r_s = 0$, stability to be expected on the basis of chance.

SUMMARY

Data based upon the responses of 1,300 subjects are tabulated to serve as a preliminary standardization of the Polydiagnostic Index. Distributions for 150 associations with the self, 30 with the motive system, 45 with the value system, 75 with the concept of the social environment, are obtained from these data. Distributions are statistically corrected for age representation to the 1950 U. S. Census, and are presented separately for males and females.

Preliminary data on the test-retest stability of individual association patterns are also presented, and suggest that on the average 81 per cent of association scores may be expected to change by one score position or less; an average coefficient of stability of .79.

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THE RELATION BETWEEN RATIO INDICES OF PHYSIQUE AND SELECTED SCALES OF THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY*

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A. THE PROBLEM AND ITS SIGNIFICANCE

The possible effects of the individual's structural characteristics on his behavioral development has been a central theme in research for many centuries; it has become, in recent years, a problem of importance for the general area of personality formation. From the results of research in child development as well as in relatively mature organisms, certain structural changes are recognized to occur which parallel changes in the behavior of the organism. William H. Sheldon (4) initiated a series of studies to show how this problem could be advantageously approached by an objective process, in particular the somatotyping technique, and body type classification.

The basic assumption underlying the Sheldon hypothesis is that the human species distributes itself along a continuum, and although there is overlap, can be objectively and accurately classified into body types. On the basis of this assumption, Sheldon (4, p. 30) successfully classified 46,000 subjects, and demonstrated the importance of the somatotype in body type grouping. Based on a 13-point scale, Sheldon has described the existence of 88 different combinations of somatotypes, and three major body types. A brief description of these body groupings follows (5):

> *Endomorphy* means relative predominance of soft roundness throughout the various regions of the body. . . . *Mesomorphy* means relative predominance of muscle, bone and connective tissue. The mesomorphic physique is normally heavy, hard, and rectangular in outline. . . . *Ectomorphy* means relative predominance of linearity and fragility.

Ernst Kretschmer (3), an earlier outstanding worker in this field, included in his type theory a *dysplastic* category into which he placed all individuals who presented an incompatible mixture of type characteristics in their physical development. In a further refinement Sheldon (4, p. 15) described dysplasia to be "the extent to which an individual presents different somato-

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types in different regions. Quantification of dysplasia is possible to a degree, by regarding the body as made up of a specific number of regions and by somatotyping each region separately."

Sheldon indicated the existence of a large group of population in which the basic components of physique would be nearly in balance. This type was found to exist in large enough number in the group studied to warrant consideration as a possible fourth category or type. Subjects exhibiting dysplastic characteristics were thus classified as *balanced*.

The Sheldon technique for somatotyping has been described in detail in Chapters III and IV of *The Varieties of Human Physique* (5).

The present study represents the results of an effort to apply a set of standardized morphologic scales in the classification of the human species for purposes of studying the relation of these body types to certain personality traits. The personality traits were measured through the use of the Minnesota Multiphasic Personality Inventory (2). The trait variables selected for study were those felt to be most important to clinical and psychological problems, as covered in the following outline:

1. The relation between body type and the pre-psychotic tendencies of schizophrenia and hypomania.
2. The relation of body type to social-introversion.
3. The relation of body type to masculinity-femininity (interest) as measured on the Minnesota Multiphasic Personality Inventory.
4. Investigation of the practical aspects of using Sheldon's ratio indices, and standardized age tables, for somatotyping and body type classification.

B. SUBJECTS

The subjects used in this experiment were selected at random from the undergraduate population of Vincennes University. This school was singled out for purposes of this research because it draws its students from a rather similar culture, the majority of the boys being native to the immediate community where the college is located. In addition, it should be noted that the greatest percentage of the group had served in the military forces before entering college. The number of students selected for measurement totalled 181 youths.

As a college population, the group satisfied the Naccarati suggestion with reference to selection (1). Naccarati concluded that measurements for determining body type should be taken in youth, preferably between the ages of 20 and 25 years. He inferred that this group represents a population sample free from the too rapid growth in childhood on the one hand, and the tendency to gain weight, disease, and the occupational hazard found in the older group. He found college students to be very useful for morphologic research. The mean age for the group used in this research was 22 years five months.

C. TAKING THE ANTHROPOMETRIC MEASUREMENTS

The weight for each of the various subjects was taken to the nearest pound, and was measured on a Fairbanks platform scale. Such a measuring instrument has been recommended by Stolz (6). Standing height was measured with the subject standing with heels, buttocks, and head against the flat surface of a wall. On this wall had been pasted a paper scale, marked in tenths of inches. Subjects were asked to stand as tall as possible without changing the contact of the feet with the floor. Standing height was recorded to the nearest tenth of an inch, and before each measuring session the scale was checked for accuracy. A steel measuring tape was used in this checking procedure.

D. CALCULATION OF THE MORPHOLOGIC INDICES

The ratio index of a subject was computed with the aid of a nomograph. Sheldon's (4) research has linked the ratio index with the somatotype, and his findings, based on 46,000 cases, were used by Sheldon for the determination of typical somatotypes for various ratio indices when age was known. By taking the height over the cube root of weight for each of the 181 subjects, it was possible to compute the various ratio indices.

E. CLASSIFICATION OF THE SUBJECTS

The height, weight, and date of birth for each subject used in the experiment was recorded on a work sheet. Possible combinations of somatotypes suggested in Sheldon's tables were also recorded on a work sheet. These combinations, along with the previously computed ratio indices, served to delimit and guide the process of classification of subjects.

Provision was also made for three directional observations of each subject. These included profile, front, and rear views. Classification of each subject into body type was based on the data recorded on the work sheet, height and weight tables for the standardized somatotypes, observations, and pictorial guides. The distribution of the 181 subjects among the four types according to somatotypic predominance is presented in Table 1.

TABLE 1
DISTRIBUTION OF THE 181 SUBJECTS ACCORDING TO BODY TYPE PREDOMINANCE

	Ectomorph	Mesomorph	Endomorph	Balanced
Number of cases	40	52	43	46
$\overline{X}$ age in years	21.4	22.7	23.0	22.4
$\overline{X}$ weight in pounds	142.7	166.0	182.5	155.2
$\overline{X}$ height in inches	71.1	70.4	69.8	68.4
$\overline{X}$ ratio indices	13.62	12.80	12.34	13.02

F. MEASUREMENT OF PERSONALITY

The group of 181 students were given the Minnesota Multiphasic Personality Inventory (*MMPI*). The Minnesota test was selected for purposes of this study in that it was basically a psychometric instrument designed to provide in a single test, scores on certain of the more important phases of personality. Scores on the schizophrenia, hypomania, masculinity-femininity, and social-introversion scales were selected from the inventory for use in this experiment. Since much of the previous work in this field has involved the evaluation of one or more of these personality traits, selection of the MMPI scales hinged primarily on these previously established trends.

The instrument itself, composed of 566 statements, covers a wide range of subject matter—from the physical condition to the moral and social attitudes of the individual being tested. Items are answered true or false, and the test is relatively easy to administer.

As to the validity of the instrument, it was reported by the authors that a high score on a scale is indicative to a degree of 60 per cent accuracy of the presence of the trait to an abnormal degree. Test-Retest reliability coefficients reported for the *MMPI* on the four scales used ranged from a low of 0.59 to a high of 0.91 (2, p. 6).

G. PRESENTATION OF THE FINDINGS

The research conclusions of Sheldon identified the ectomorphic body type with schizophrenic and social introvertive tendencies. This same investigator characterized manic-depressive reaction and social extroversion to be strongly linked with mesomorphy and endomorphy. These inferences indicated a strong innate hereditary basis for the development of types, and implied a certain degree of conformity among the various characteristics of the individual. This could imply the way in which the individual visualizes his world toward integration with it to be somewhat dependent on body type.

The rôle of body type in personality formation takes on both biological and cultural significances. The implication being that a certain organization exists among the various characteristics of the individual, and that a composite picture of the individual would be revealed in the relationship between body type and certain specific personality traits. Each specific body type would have a definite pattern, possibly common to that group.

In order to demonstrate the significance of the findings a number of systematic statistical procedures were applied to the data. The results of the test of the differences between the means can be found in Table 2.

TABLE 2

ANALYSIS OF VARIANCE OF THE VARIOUS *MMPI* SCALE SCORES OF GROUPS CLASSIFIED INTO FOUR BASIC PHYSIQUE GROUPS

MMPI scale	Analysis of variance F value
Schizophrenia (sc)	9.66*†
Hypomania (ma)	40.12*†
Masculinity-femininity (m-f)	9.40*†
Social Introversion (si)	11.90*†

*F value above one per cent level of significance.
†There was more variance between groups than within them.

A simple test of homogeneity of variance between groups was applied. This test involved the division of the separate sums of squares within the several groups by the corresponding degrees of freedom. Table 2 demonstrated the fact that there was more variance between the groups than within them. From this it was concluded that some degree of homogeneity existed within the groups.

Table 3 shows the findings with respect to the significant differences between the various groups based on the sums of squares test. Several of the F values were sufficiently large to be significant at the one per cent level.

TABLE 3

DEMONSTRATION OF THE VARIANCES BETWEEN THE GROUPS (*MMPI* SCALE SCORES)

Components of physique	Obtained value of F			
	sc	ma	m-f	si
Mesomorphy-Ectomorphy	3.05†	1.15	2.52†	1.87*
Endomorphy-Ectomorphy	2.91†	1.23	1.94*	1.12
Balanced-Ectomorphy	2.14†		1.83*	1.09
Mesomorphy-Endomorphy			1.30	1.67*
Mesomorphy-Balanced	1.42		1.37	2.07†
Endomorphy-Balanced	1.35			1.23

*F value significant above five per cent level.
†F value significant above one per cent level.

A number of correlations between ratio indices of physique and the various clinical scales were attempted. Table 4 discloses the fact that seven of the 12 correlations computed were sufficiently large to be significant at the one per cent level. Those (*r*'s) designed to test the Sheldon hypothesis were all significant at the one per cent level.

TABLE 4
CORRELATIONS (*r*) BETWEEN RATIO INDICES OF PHYSIQUE AND SCORES ON THE VARIOUS *MMPI* SCALES

		Measures of physique	
Correlations	Number = 92 ectomorph mesomorph+	Number = 83 ectomorph endomorph+	Number = 95 endomorph mesomorph+
Schizophrenia	+0.44†	+0.46†	—0.08
Hypomania	—0.67†	—0.51†	+0.17**
Masculinity-femininity	+0.31†	+0.12	—0.17**
Social Introversion	+0.51†	+0.23†	*0.33†

†Correlation significant at one per cent level.
*Correlation significant at five per cent level.
**Correlation significant at ten per cent level.

Statistical findings in this group of 181 subjects classified into body types revealed the ectomorphic group to have the highest schizophrenia and social introversion Scale scores, with the mesomorphic group having the highest hypomania Scale scores, and the lowest social introversion Scale scores. These findings in the mesomorphic group are particularly significant in that the endomorphic group had the lowest range of ratio indices.

Significant coefficients of correlation were found as a result of the above relationships. Many previous research findings failed to find correlative values above low and meaningless levels. It is also possible that the improved plateau of correlations found in the present research was due partially to a more accurate identification and description of the various personality traits. This would apply very definitely in the case of the mesomorphic group. Considerable future research must be devoted to a further evaluation of the categories, and particularly to the balanced body type, towards its possible inclusion as a major sort.

H. CONCLUSIONS

Particular body types, determined by the Sheldon technique, have been studied in relation to the scores of a group of 181 students on four *MMPI* scales. The statistical implications obtained have been rather consistently in the direction suggested by Sheldon and others, and also by the continuity between physical and psychological makeup. It may possibly be concluded from the results of this study that the first step in an investigation of this nature seems to lie in a more adequate description and a more accurate identification of the various trait variables.

The magnitude of the correlations and differences reported here possibly suggest a route whereby this problem may be explored beyond the superficial level. It seems apparent to this investigator that if we are to probe below the surface, there is a definite need for the application of standardized procedures to the problem of identification and evaluation of certain root factors in personality. This inquiry represented an attempt at just such an approach, recognizing that human personality takes shape in the form of a complex system of traits and variables.

In future examination of factors operative in human personality, the need will arise for an extension of these original investigations on a longitudinal basis. Utilization by the social scientist of this rather neglected technique could lead to the discovery of the full reality of the personality-body type bond. It is also conceivable that if social science is to be freed from irrelevancies and confusions in this area, further analysis of involved behaviorisms are imperative.

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INHIBITION AND TACHISTOSCOPIC THRESHOLDS FOR SEXUALLY CHARGED WORDS*

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A. PROBLEM

The tachistoscopic presentation of word stimuli offers a method for estimating quantitatively the ease or difficulty with which a subject recognizes specific stimuli. When the mechanical and physiological factors determining recognizability (such as visual acuity, word length, complexity of word structure, and familiarity) have been controlled, the occurrence of high thresholds have been considered by some investigators to be related to emotional factors within the subject, blocking his recognition of the stimuli. For example, McGinnies (3) demonstrated in a group of college students that the tachistoscopic thresholds for sexually charged words were significantly higher than those for uncharged words and he felt that this constituted experimental support for "perceptual defense." Postman et al. (4) offered a different explanation; these workers thought that the sexual words were less familiar than the neutral words and hence more difficult to recognize. In their own study, Postman and his co-workers attempted to control for the factor of familiarity and found no evidence of higher thresholds for sexual words.

One important aspect of the problem that seems to have been neglected is the meaning of individual differences in tachistoscopic thresholds. In McGinnies' study, some of the subjects showed only a small difference between their thresholds for charged and uncharged words while others showed a substantially larger difference. It is our point of view that such differences in thresholds are related to the individual's degree of inhibition. To test this we devised an experiment in which subjects would be given tachistoscopically presented sexual and non-sexual words and projective personality tests, the projective tests serving as a means for determining the degree of inhibition. We hypothesized that subjects who manifested high tachistoscopic thresholds to the sexual stimuli would be characteristically inhibited, restrained and constricted on the projective tests, while those showing low

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thresholds would be relatively unrestrained and uninhibited on the projective tests.

B. PROCEDURE

Thirty-nine female, elementary psychology students at Brooklyn College constituted the subject group. Such variables as age, sex, education, number of psychology courses completed, and *IQ* were comparable. All subjects had approximately 20-20 vision as determined by their reading of a standard eye chart.

Each subject was given an individually administered Rorschach and Machover Figure-Drawings Test. The Rorschach was administered and the protocols scored according to the methods suggested by Klopfer and Kelley (1) while the drawings were administered according to Machover's suggestions (2).

The Rorschach protocols and drawings were then presented to two psychologists, each having seven years of clinical experience, who were then asked to place every Rorschach and drawing set into one of five categories ranging from "least inhibited and constricted" to "most inhibited and constricted." The psychologists made their ratings separately with no information about the subjects, other than their test protocols. The ratings were made on the basis of a global impression based upon clinical experience and judgment.

The subjects were then given the tachistoscopic test. In the tachistoscopic procedure the subject was comfortably seated in an 11′ x 11′ room, at a distance of 9 feet from a translucent glass screen upon which the stimulus words were projected. Each subject was told that she was going to be shown some words that would be flashed on the screen before her. A clicking sound two seconds before each word appeared, was used to alert the subject. Instructions were given to report whatever was seen each time a word was flashed. The charged and uncharged stimulus words are listed in Table 1 in the order presented.

A trial run with three neutral words was first used to establish an approximate threshold level and also to familiarize the subject with the test procedure. In the actual experiment such stimulus words were first exposed at a level well below the individual's threshold. Succeeding exposures were increased in graduated steps, 10 millisecond increments under 100 milliseconds, 20 milliseconds below 200, etc. Exposures continued until the subject reported the word correctly. Subjects were asked not to discuss the experiment with their classmates and all subjects denied having prior knowledge as to the nature of the stimulus words.

TABLE 1

CHARGED AND NEUTRAL WORDS IN ORDER OF TACHISTOSCOPIC PRESENTATION

1.	music	7.	*rape	13.	farm
2.	*Kotex	8.	grass	14.	*bitch
3.	wood	9.	trade	15.	also
4.	about	10.	each	16.	north
5.	*penis	11.	*hell	17	*whore
6.	warm	12.	west	18.	clear

*Indicates charged words.

Each subject was asked if she had delayed verbal report of any of the stimulus words. Since approximately one-half of these admitted inhibiting their report of the first charged word (and a very few of these delayed in reporting other charged words) corrected values were employed in the computation of mean thresholds. The subject's recall of the exposure at which actual recognition occurred was used in the computation of mean thresholds rather than the exposure at which correct verbalization took place.

C. APPARATUS

An electronically controlled tachistoscope,[1] consisting of a projector and a timing control unit was employed. The light source used was a permanently heated fluorescent tube which offered an instantaneous rise and decay of light. The control unit allowed for exposure durations of from .01 to 1 second (in .01 steps) through the adjustment of panel switches. The changing of slides and the presentation of exposures were initiated by a push button switch.

All apparatus was located outside the experimental room. The projector was 28 inches from the screen with a wood cone connecting the two so as to negate the effect of outside light sources.

Subjects were presented with a list of four- and five-letter words shown in Table 1. The neutral words were chosen from the Thorndike-Lorge word book (5) from the first 1,000-word list. The words appeared on a translucent screen as white figures on a dark background. The slides were prepared in such manner as to insure uniformity of light transmission.

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[1] The tachistoscope was designed by M. Tobin, Instructor in Psychiatry (Biophysics), of the State University of New York, College of Medicine, New York City.

D. RESULTS

Five categories representing different degrees of inhibition were set up, Category 1 representing little inhibition and Category 5 great inhibition. The reliability of the psychologist's judgment of the projective test protocols was determined by correlating the individual ratings. The *r* between the ratings of the two psychologists was +.65 (significant at the .01 level of confidence).

An inhibition score for each subject was obtained by totaling the individual ratings of the psychologists. Thus a subject might range from a theoretical low in inhibition of 2 to a theoretical high of 10.

The mean recognition thresholds for neutral and charged words were determined for each subject. (With two exceptions all 39 subjects showed higher mean thresholds for charged words than neutral words.) Absolute difference in threshold was determined by subtracting the mean time of recognition of the uncharged words from the mean time of the charged words. Per cent differences in thresholds were computed by dividing the absolute difference by the mean time of recognition for the uncharged words.

Table 2 compares the inhibition score with absolute difference in threshold and per cent difference in threshold for each subject.

The correlation between inhibition score and absolute threshold difference is +.62 and the correlation between inhibition score and percentage difference in threshold is +.64, both significant at the .01 level of confidence.

E. DISCUSSION

The experiment indicates that subjects who give evidence of inhibition and emotional constriction on projective tests are generally inhibited in responding to sexually charged words in the tachistoscopic situation. On the other hand those subjects who are relatively uninhibited on projective tests tend to show little inhibition in their responses to sexual words. Thus the tachistoscopic presentation of sexually charged and uncharged words seems to offer a method for arriving at an index of the degree of inhibition within an individual.

In experiments utilizing thresholds for "emotionally charged" and neutral words the issue of controlling the familiarity of the words has been often raised. How does this apply to our experiment? Since we were concerned with individual differences among subjects in their recognition of sexual and non-sexual words, and all subjects were presented with the same words, it does not matter whether sexual words are generally more unfamiliar

TABLE 2
INHIBITION SCORE, ABSOLUTE DIFFERENCE (MILLISECONDS), AND PER CENT DIFFERENCE IN THRESHOLDS FOR CHARGED AND UNCHARGED WORDS FOR EACH SUBJECT

Subject	Inhibition score	Absolute difference	Per cent difference in thresholds
A	2	7	13
B	2	8	14
C	2	3	5
D	2.5	20	15
E	3	— 5	— 9
F	3	7	13
G	3	0	0
H	3.5	2	4
I	4	7	12
J	4.5	65	58
K	5	11	20
L	5	28	39
M	5	20	25
N	5	8	14
O	5	10	20
P	5	10	25
Q	5	15	39
R	5.5	22	37
S	5.5	3	5
T	6	17	34
U	6	4	4
V	6	6	14
W	6.5	13	26
X	7	33	67
Y	7	8	19
Z	7	3	6
AA	7	4	5
BB	7.5	59	80
CC	7.5	75	115
DD	8	26	44
EE	8	34	79
FF	8	9	17
GG	8	79	100
HH	8.5	26	50
II	8.5	101	194
JJ	8.5	86	94
KK	9.5	39	57
LL	10	114	178
MM	10	53	58

than non-sexual words. It may be argued, however, that for some subjects the sexual words may have been more unfamiliar than for other subjects and consequently these subjects had a higher threshold of recognition for sexual words. All subjects came from a relatively homogeneous group and were exposed to similar cultural influences. If some of the subjects were relatively unfamiliar with sexual words, it is likely that either their personality dynamics were such that they could not accept sexual words, even though they had been exposed as much to them as had the other subjects, or that they lived in a particularly repressive environment in which sexual words were rarely heard. In the former case one must assume that emotional blocking had typically occurred in the past whenever sexual words were heard or seen. In the latter case our data suggests that living in repressive surroundings is related to general constriction and inhibition in personality. In any event, whether or not there were differences in familiarity to sexual words among our subjects, high thresholds to sexual words on the tachistoscope seem to be related to inhibited personalities.

The results are consistent with the clinical view that individuals have characteristic styles or defenses in the way they respond to life situations and that they tend to employ these defenses or modes of responding from situation to situation. Our data does not tell us specifically how the style of reaction or defense, in this case "inhibition," operates. In the tachistoscopic situation we cannot ascertain whether delay in reporting sexual words was on a conscious or unconscious basis. Was it the subject's failure to perceive the stimuli or merely an unwillingness to verbalize sexual language that accounted for increased thresholds on the tachistoscope? We made some attempt to control the last possibility by carefully questioning each subject after the tests. When a subject reported withholding a correct response, a relatively rare occurrence, the corrected time was used in the computations.

We also do not know specifically how inhibition operates on projective tests. In this experiment psychologists made judgments as to how inhibited a person was by a global clinical impression based on a variety of factors present on the person's Rorschach and figure drawings. The psychologists reported that they made use of such test factors as total number of responses, color responses, sexual content on the Rorschach, and size, placement, and omission of bodily parts on the figure drawings, although each psychologist emphasized somewhat different factors in arriving at his final judgment. However, it is still undetermined how many of these test factors are actually related to "inhibition" and if they are what is the nature of the relationship. This is an area for further study.

Attitudes toward sexuality are greatly affected by the cultural milieu. It would be important to extend this study to populations with different backgrounds. Would unskilled laborers with a grammar school education respond similarly to the college group of our study? It would also be important to see if we would obtain similar results with other emotionally charged stimuli, such as aggressive words.

F. SUMMARY

Thirty-nine female college students were administered a tachistoscopic test in which sexual and neutral words were presented. The students were also given a Rorschach and Machover Figure Drawings Test and the projective tests were judged as to the degree of "inhibition" shown. "Inhibition" on the projective tests was found to be related to differences between thresholds of recognition for the sexual and neutral words.

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THE THEORETICAL INTERPRETATION OF ERRORS IN SYLLOGISTIC REASONING*

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Experimental studies have shown that errors in syllogistic reasoning among normal adults may be increased by abstract and unfamiliar material (3, 5, 6), factually or valuatively unacceptable conclusions (1, 2, 3), and similarities between the premises with respect to verbal form (3, 4, 7). Such studies, however, have characteristically neglected to distinguish the various mechanisms by which these factors can influence the reasoning process and to separate experimentally the errors attributable to each such mechanism. The interpretation of syllogistic reasoning as a classifying process provides a frame of reference within which this problem can be dealt with systematically.

To *classify* objects, in the present sense, is to place them in specified categories on the basis of a stipulated criterion. Errors in classifying may involve (*a*) carelessness in the sense of accidental responses contrary to intention or non-coöperative random responses, (*b*) a general inability to grasp the concept stipulated as the criterion, (*c*) the inability to differentiate this concept from another which when applicable takes precedence as a basis of response, or (*d*) the imperfect development or impairment of the operation of "classification" itself. In syllogistic reasoning the objects to be classified are syllogisms and the stipulated criterion is the "logical validity" of the conclusion as a deduction from the given premises. Errors in syllogistic reasoning may thus involve (*a*) carelessness in the above sense, (*b*) a general failure to grasp the concept of "logical validity," (*c*) the specific inability to differentiate "logical validity" from another attribute of syllogisms, or (*d*) imperfections in the classifying operation.

To illustrate the applicability of these distinctions we may consider a hypothetical experiment in which the subject is directed to classify, according to the criterion of logical validity, a number of syllogisms with conclusions of six types: valid-true, valid-false, valid-nonfactual (lacking factual content), invalid-true, invalid-false, invalid-nonfactual. We shall assume that the

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syllogisms are selected so as to minimize all potentially distorting factors other than factual status, and that the factual status of each conclusion is clearly known to the subject.

Since adherence to either the logical or the factual criterion, or vacillation between them, would yield correct classifications of all valid-true and invalid-false syllogisms, the failure to classify any such syllogism correctly must be attributed to uncontrolled factors including carelessness in the above sense. If the proportion of *these* syllogisms which are incorrectly classified is small, we may conclude that uncontrolled factors are not influencing responses to any great extent, and that the given experimental situation thus provides a basis for determining the effect of the factual status of conclusions, as recognized by the subject, on his ability to adhere to the criterion of logical validity. We shall assume this to be the case.

Were the factual status of conclusions to influence the classification of syllogisms, this would lead to errors in classifying valid-false and invalid-true syllogisms, but not valid-true or invalid-false syllogisms. If, therefore, the proportion of valid-false and invalid-true syllogisms which are incorrectly classified is not significantly greater than the proportion of incorrectly classified valid-true and invalid-false syllogisms, such errors should be attributed to uncontrolled factors. If, however, the former proportion exceeds the latter significantly, we must assume that the factual status of conclusions is influencing the response. The question then arises: What is the mechanism by which such influence is effected?

If the proportion of correct classifications of nonfactual syllogisms is not significantly greater than random responses would yield, this indicates that the subject has no general concept of "logical validity" and is thus unable to make correct deductions (i.e., correct classifications with this concept as the criterion) except spuriously. If, however, the proportion in question is significantly greater than would be likely by chance, we should assume that the subject does have a concept of logical validity and a general capacity to make logical deductions, but that this capacity is interfered with, in connection with valid-false and invalid-true syllogisms, either by the inability to differentiate logical from factual considerations or by imperfections in the capacity to classify consistently, in terms of a stipulated criterion, objects which vary also with respect to a more personally relevant characteristic.

To distinguish between these two latter alternatives, we must ask the subject first whether each conclusion is true or false, and then whether it represents a valid or an invalid deduction. If, by responding correctly to the second question in a significant proportion of cases, he demonstrates an ability to classify separately in terms of logical and factual criteria when the distinction between them is thus directly facilitated, we may by elimination of the other alternatives attribute the unexplained original errors in classifying valid-false and invalid-true syllogisms to deficiencies in the classifying operation itself. Otherwise such errors should be attributed to the inability to differentiate the logical from the factual criterion. This means that the subject is dealing with logical status as if it were merely an indicator of factual status to be employed only when the latter cannot be determined directly, rather than an independent criterion which can be applied simultaneously with and separately from the latter.

A distinction must first be made, then, between reasoning which is correct beyond chance expectations *only* when facilitated by adherence to a particular non-logical criterion which fortuitously coincides with the criterion of logical validity in its distribution among the syllogisms, and reasoning which, with other distorting factors eliminated, is correct beyond chance expectations *except* when this non-logical criterion is distributed so as to indicate classifications different from those which the logical criterion would yield. The decisive cases, in connection with this distinction, are those in which the given non-logical criterion is inapplicable and hence can neither "help" nor "hinder" reasoning.

The second of these possibilities may, furthermore, involve either of two alternatives. One is that, although logical validity can be adhered to in some contexts, it is conceptually undifferentiated from another characteristic and is superseded as a basis for response whenever the other characteristic is present. This means not merely that one concept dominates, or takes precedence over, another—for such is the observed fact itself, of which this represents one possible interpretation—but rather also that the domination occurs by virtue of the inability to recognize a particular conceptual differentiation. The applicability of this interpretation depends upon evidence that such a differentiation cannot be made by the subject even under ideal experimental conditions. The other possibility is that the classifying operation is defective. To avoid errors one must *both* differentiate "logical validity" from all other characteristics of syllogisms *and* classify syllogisms consistently in terms of this criterion. A failure in the latter respect involves the domination of one concept over another as a basis of response, but not the true assimilation of one into the other in a manner which precludes recognition of a distinction between them. It involves not an inadequate grasp of concepts or distinctions prerequisite to logical deduction, but rather merely an instability in the boundaries of the field of attention.

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